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Agency Costs and Moral Hazard Under the New Banks' Capital Regulation: Diagnosis, Modelling and Solutions

Jorge Martín Cerón

Department of Economics

Birkbeck and University College London (UCL) - Bloomsbury

Program

University of London

A dissertation submitted for the degree of

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February 2017

To my wife, son and daughter

Abstract

This thesis investigates the agency costs and moral hazard associated with the new capital regulation for banks in the event of balance-sheet losses. The recent introduction of "Bail-in" provisions, under which unsecured creditors must contribute to banks' rescue through recapitalisation, and the regulatory stipulation of higher equity requirements, will have profound effects on the traditional agency relationships between shareholders and bondholders of banks. These Bail-in provisions imply, "Deviations from the Absolute Priority Rule" (DAPR). This dissertation undertakes quantitative and qualitative analyses of the new Bail-In structures, focusing on their microeconomic consequences that lead to perverse incentives of the equityholders and subsequently propose practical solutions to the identified problems. The first main result reveals that Bail-in could actually aggravate the agency costs by intensifying the "wealth transfer" from bondholders to equityholders. The second main result is to demonstrate that enforcing higher monitoring costs to the bondholders reduces equityholders' incentive for moral hazard via higher cost of capital. The use of financial and non-financial covenants within the "Bail-In-Able Debt" indenture has been proposed as practical solutions to facilitate bondholders' monitoring efforts. However, close to the Point of Non-Viability covenants are no longer effective as the risk of DAPR looms, and the equityholders are tempted to attempt "gamble-for-resurrection". To attenuate this distortion of shareholder incentives, Bail-in provision must impose some cost on shareholders. They could be made to face significant dilution, through a fair debt-to-equity swap with bondholders at market prices, or face full dilution via private expropriation by a new shareholder base that we term "Contingent Equity Base". This is the third main result. Overall, this dissertation makes a significant step forward into the understanding

of the microeconomic consequences of the new bank's capital regulation in general and the Contingent Convertibles in particular whilst offering practical solutions to the problems.

Summary of Thesis

This thesis investigates the agency costs and moral hazard associated with the new capital regulation for banks ("Basel III"). It is concerned with the aggravation of the perverse incentives from shareholders as we believe their "appetite" to increase risk, as the solvency of the bank deteriorates, increases relative to the previous regulatory framework ("Basel II"). We believe so as the new capital regulation under Basel III replaces "Bail-out" (the regulator rescues the bank protecting stakeholders' investment including equityholders) for "Bail-in" (where both equity and bondholders rescue the bank before any regulator intervention but the latter takes losses before the former's investment is fully consumed). This new restructuring proceeding is articulated statutorily through resolution regimes (regulator has power to impose losses on stakeholders) or contractually through Contingent Convertibles ("CoCos"). A CoCo is a fixed income bond (dated or perpetual) that absorbs losses via equity conversion or principal writedown/off once a minimum solvency ratio has been breached (usually the Core Tier 1 - equity minus intangibles in a nutshell- falls below 7 percent or 5 percent).

In the event of balance-sheet losses for an investment/commercial bank, the Absolute Priority Rule (APR) specifies the pecking order whereby banks must meet their liabilities. In particular, the banks' depositors or bondholders should not bear losses until equityholders have been fully impaired. Then, the pecking order follows on with bondholders and ultimately with unsecured depositors. However, due to the convex nature of the equityholders' payoff - the loss is limited to the value of their holdings while the potential profit is limitless - leads to an agency problem where equityholders are incentivised to take sub-optimal high risks. Since some banks are systemic entities, financial regula-

tors tend to rescue troubled banks (Bail-out) to minimise financial instability and prevent depositor runs. Historically such Bail-outs have exacerbated the intrinsic moral hazard within the banking industry. The recent introduction of Bail-in provisions under Basel III, whereby unsecured creditors must contribute to banks' rescue through recapitalisation, and the regulatory stipulation of higher equity requirements, will have profound effects on the traditional agency relationships between the shareholders and bondholders of banks. These Bail-in provisions imply, "Deviations from the Absolute Priority Rule" (DAPR). The CoCo, the most illustrative example of the Bail-in provisions, stipulates that should the solvency of the banks fall below a threshold, bondholders are written down/off or converted into equity whilst there is still equity left in the bank's balance sheet. This feature alters the traditional pecking order of the APR that gives rise to perverse incentives which we believe they are even higher from those existing under the old banks' capital regulation.

This dissertation undertakes quantitative and qualitative analysis of the new Bail-In provisions, more particularly on CoCos, focusing on the microeconomic consequences that leads to perverse incentives of the equityholders. It subsequently proposes practical solutions to the identified problems. Moreover, it conducts an empirical analysis on the impact of Bail-in and CoCos on the cost of capital of banks to prove that the WACC of the banks is poised to rise under the new bank's capital regulation. The increasing cost of debt more than outweighs the decreasing cost of equity stemming from the higher overall equity requirements.

The thesis initiates with a comprehensive assessment of both Basel II and III with special emphasis on the structure of the Bail-in framework and CoCos to stand the reader on good stead to progress on the subsequent chapters in which a thorough analytical study is undertaken to demonstrate the increasing agency costs arising from the breach of the APR.

There are several practical results emanating from this thesis.

The first main result reveals that Bail-in could actually aggravate the agency costs by intensifying the "wealth transfer" from bondholders to equityholders. Academics such as Berg and Kaserer (2011) have studied the inducing risk taking effect ("wealth transfer") of the CoCo bonds. However, our conceptual approach and our analytical framework are

different from theirs since we tackle the agency cost problem from both the wealth transfer and the value destruction angles (in depth review in Chapter 5). Furthermore, we also determine that both Bail-in provisions and CoCos create incentives for bondholders to monitor the investment choices of managers, as the former are exposed to losses even when the bank is still operationally viable (going concern bank). The costs of monitoring are ultimately borne by shareholders via higher cost of capital ("Pigouvian tax").

In addition to this, we also underscore that the new CoCo structures amplify the agency costs compared with the traditional banks' restructuring with debt-to-equity swaps, given the uneconomical terms for bondholders in the event of a bank restructuring. We term it "NADES" ("Non Admissible Debt to Equity Swap") given bondholders' debt to equity swap terms are set in advance in the bond documentation and thus, Coco holders have no negotiation power during the restructuring process. This is a stark contrast with the traditional restructuring proceedings for "distressed" firms in which both shareholders and bondholders collaborate together to facilitate the prompt recovery of the company to quickly emerge from restructuring. Bondholders are at the mercy of shareholders.

This and others are all new features which have not been addressed previously by the academic world and we endeavour to explain in detail.

The second main result here is that, using a novel indifference curve analysis, enforcing higher monitoring costs to bondholders reduces equityholders' incentive for moral hazard via higher cost of capital. We propose using financial and non-financial covenants within the CoCo bonds to facilitate bondholders' monitoring efforts. These covenants are contractual clauses that limit the banks' ability to increase leverage or reduce solvency to extract wealth from bondholders. However, agency costs are not entirely mitigated through the use of these covenants. Once the bank's solvency deteriorates towards the PONV (Point of Non Viability for the bank. Take 7 percent Core Tier 1), covenants are no longer effective as the risk of DAPR looms, and the equityholders are tempted to attempt "gamble-for-resurrection".

The third result is that, in order to fully remove this distortion of shareholder incentives, we believe Bail-in provision must impose some cost on shareholders. These can be articulated in various ways:

- Force equityholders to face significant dilution, through a fair debt-to-equity swap with bondholders at market prices (and not at contractual prices as set by the CoCo bond indenture).

- Face full dilution via private expropriation by a new shareholder base. This is our new radical proposal, the CEB (Contingent Capital Base) structure.

The former aims to tackle the agency cost whereas the latter seeks to mitigate the intrinsic moral hazard of the banking industry. Only when shareholders stand to lose their entire investment can moral hazard be attenuated. The CEB facilitates a scheme that enables the bank to operate as a going concern after incumbent equityholders have been fully expropriated thereby eliminating the perverse incentive of Bail-in and CoCos since shareholders face, since the beginning, the possibility of losing their entire investment (without putting the bank into resolution).

Overall, this dissertation makes a significant step forward into the understanding of the microeconomic consequences of the new bank's capital regulation in general, and the Contingent Convertibles in particular. It proposes innovative solutions to mitigate the intrinsic agency costs embedded in the new financial regulation and potentially erases the inherent moral hazard of the banking industry. We believe this innovative and cutting edge piece of academic work seeks to tackle (rather than highlighting) the intrinsic aggravation of the agency costs (via perverse incentives) embedded within the Bail-in provisions, in particular within CoCos.

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Preface

This dissertation is my own work and contains nothing which is the outcome of work done in collaboration with others,

except as specified in the text and Acknowledgements. The dissertation does not exceed the regulation length of 60,000 words, including tables, footnotes and appendices.

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Chapter 1

Introduction

The 2008 financial crisis triggered unforeseeable economic, social and political consequences. Moreover, it prompted an overhaul of the previous banking regulatory framework, namely, Basel II. Basel II has been criticized for its inability to properly model banks' investment risks as well as for the lack of going concern loss-absorbing of its capital instruments (subordinate debt). Moreover, the lack of standardized liquidity and funding ratios within the regulatory scheme discouraged banks from holding liquid assets. However, they were encouraged to run balance sheet duration mismatches which eventually instigated widespread Bail-outs. Basel III, the new regulatory framework, is now underway and seeks to address banking regulation from three fronts: solvency (higher equity requirements coupled with lower leverage and loss-absorbing capital), liquidity and funding (more liquid assets to cope with sudden liquidity collapses and better duration matching between assets and liabilities).

Basel III aims to dampen moral hazard and risk taking from banks (overinvestment) and reduce the debt overhang (underinvestment) that hampers investment and lending when capital levels are low. Previously, any systemic bank fallout was dealt with by the regulator (and ultimately the tax payers) through public funds-based capital injections to avoid general panic in the system and the negative knock-on effect on the real economy. This was the so-called Bail-out where the regulator stepped in and recapitalized the bank to restore solvency. From now on, banks' private investors, (including equityholders and

bondholders) will participate in any recapitalization exercise by assuming losses on a going concern basis to mitigate the negative repercussions of a bank's liquidation. Going forward in ailing bank, shareholders will take the first loss and, from that point, bondholders, either through contractual (bond documentation) or statutory (regulator through Resolution Regimes is allowed to impair unsecured bondholders at his own discretion) means will take the second loss upon a regulatory event (when losses breach a solvency trigger). Under the traditional absolute priority rule (APR), bondholders should not bear losses until shareholders have been wiped out. Since the banks are systemic entities, the regulator has so far largely rescued troubled banks ("Bail-out") to minimize market disruptions and deposit runs, which have historically exacerbated the intrinsic moral hazard of the banking industry. The introduction of going concern Bail-in and higher equity requirements will have a profound effect on the traditional agency relationships within a bank, namely shareholders vs bondholders. We argue that the current regulatory framework could actually lead to an aggravation of the agency costs (and potentially worsen the intrinsic moral hazard of the business) due to an intensification of the wealth transfer from bondholders to equityholders owing to the DAPR¹. The current structure of the "Bail-in able debt" (CoCo - Contingent Convertible or Principal Writedown Based Bonds) also magnifies the agency costs as we argue in the thesis. Thus, this thesis undertakes quantitative and qualitative analysis of these new structure from a microeconomics standpoint and we also propose some practical solutions to tackle the inherent agency cost of Bail-in.

The thesis is structured as follows. Chapter 2 offers an extensive literature review of the most relevant academic contribution on agency costs, Bail-in and CoCos. Chapter 3 offers an overview of the traditional agency cost theories where the main agency problems are highlighted which will serve as a preamble of the following sections. Chapter 4 introduces the current (Basel II) and future capital structure (Basel III) of banks as well as the introduction of new concepts such as Bail-in, contingent capital, TLAC (Total Loss Absorbing Capacity) etc. Basel III is proposing two types of contingent bonds within its Bail-in framework: CoCo (Contingent Conversion into shares) and "Bail-in able" bonds

¹Deviation from the Absolute Priority Rule.

in the form of Permanent Principal Writedown/Off (PPW). As we argue throughout the thesis, the latter illustrates the stark DAPR from the new Basel III capital structure that aggravates, instead of alleviate, the agency costs. As we transition into Basel III, bondholders will no longer evaluate their debt instruments on a PD basis (Probability of Default) but on PB (Probability of Bail-in) one which will prompt them to incorporate this higher investment risk into the bonds. They will also drive future relationships between bondholders and equityholders, thereby altering the agency costs within the bank. Chapter 4 also conducts a thorough review of the CoCo market, trends, performance and investor base to name a few, in order to enable the reader to familiarise with this new capital eligible security for banks.

In Chapter 5 we investigate the main shortcomings of the new financial regulation as a whole and of the CoCos in particular, which is the overlook of the impact on the agency costs. We first describe in detail the payoffs for several Bail-out and Bail-in scenarios laying out the set up and the assumptions underpinning each of them to prove that Bail-in leads to perverse incentives. As we move on, two elements of agency costs are investigated. The first is the wealth-transfer problem, where the equityholders are incentivized to embark on riskier projects because of the long option position held by them, and "sold" by the guarantors: the government in the Government Bail-out case and the bondholders in the Bail-in cases. Higher volatility of the projects' values means higher option value, leading to wealth being transferred from the guarantors to the equityholders. The second is the value destruction problem, where in a falling solvency scenario the equityholders are tempted to "gamble-for-resurrection", i.e. sacrifice value for higher volatility. We investigate these as the unintended consequences of the deviation from absolute priority rules (DAPR) once the CoCo has been converted. We also discuss the trade-off between risk and returns (value) for equityholders under four different restructuring scenarios (Full Expropriation, Writedown/Off Bail-in CoCo, Bail-out with ordinary/preference shares, Equity Conversion Bail-in CoCo) using indifferent curves (a la Jensen and Meckling (1976)) to analytically prove that Bail-in in general and CoCos in particular lead to an aggravation of the agency costs and wealth transfer. We also underscore that agency costs lead to monitoring costs (since bondholders will bear losses on a going concern basis in the future) for bondholders

which are ultimately borne by equityholders via higher cost of capital.

In Chapter 6, we argue that the use of covenants (in the same way as those of a Corporate bond) within the CoCo indentures can mitigate risk taking (and thereby hold down agency costs). When the solvency ratios are high, shareholders have less incentives to take on risky investments as this will be swiftly captured by bondholders that will incorporate this risk taking within the bonds as higher risk premium. In this chapter, we take one step forward and suggest two more effective ways (beyond covenants) to mitigate agency costs and potentially remove the intrinsic moral hazard in the banking business: a Market Price based Going concern Equity conversion CoCo (with no pre-set conversion price nor conversion ratio) that exchanges into shares at market price and suggests a New Contingent Equityholder Base (CEB) structure that sets in and replace the incumbent equityholders once the CoCo is triggered or the solvency falls below the PONV. These two novel solutions aim to dampen the agency costs stemming from Bail-in and CoCos².

Our first solution aims at better tackling the agency cost while the second one is conceived to permanently erase the intrinsic moral hazard of the banking industry. Through a combination of both, we believe the perverse incentives from equityholders can be fully removed³. In summary, Chapter 4 identifies the agency cost problem whereas Chapter 5 and 6 go about the detailed technical analysis as well as the identification of effective and practical formulas to dampen or remove the agency cost of Bail-in.

Finally, in Chapter 7 we analytically investigate the potential impact of the new Financial Regulation on the cost of capital. Contrary to some scholars (Admati (2013)), we argue that the cost of capital in banks is poised to significantly rise despite the supposedly lower cost of the equity owing to the increasing Bail-in (and lower leverage) related cost of debt.

There are several reasons why this thesis substantially contributes in many ways to the recent Financial Regulation research. Generally, we argue firmly that

²So far the academic proposals have been more focused on identifying the overinvestment problem of CoCos rather than suggesting solutions to mitigate or eventually remove it.

³Furthermore they somehow compensate bondholders from the DAPR (without undermining their monitoring efforts) once the CoCo is converted into shares improving the payoff profile of their option.

- The nuances of the new financial regulation, especially Bail-in, gives rise to agency costs and to a potential aggravation of the moral hazard. Nobody has advocated this more than the author of this thesis.
- Agency costs lead to monitoring costs that are in the end borne by equityholders via higher cost of capital.
- A higher cost of capital in banks is expected as a result of Bail-in provisions (including Senior bonds), higher equity, monitoring costs etc., that more than outweighs the supposedly lower cost of equity as argued by several scholars (Admati et al, (2013)). Higher cost of capital can be employed as a "Pigouvian tax" - like tool to mitigate the agency costs of Bail-in.
- Covenants, as well as a full revision of the CoCo structures (with our Market Price based CoCo) can significantly mitigate agency costs albeit they cannot fully remove it.
- Full expropriation of equityholders without the contribution of public funds is the only way to erase the intrinsic moral hazard of the banking business. Our proposals aim for that.
- The aggravation of the debt overhang on the back of the new liquidity measures, namely NSFR (Net Stable Funding Ratio). Please see appendix for a comprehensive review on this topic.

All of the above are new topics within the literature of the Microeconomics of Financial Regulation, raising an interesting body of research for the future.

Furthermore, this thesis encompasses key analysis and concepts that are addition to the existing literature and will be at the forefront of the new capital regulation academy. These include:

- The improvement of the profile of the CoCos payoff (CoCo Condor) by incorporating features such as partial conversion or the NADES (Non Admissible Debt to Equity Swap) concepts which have been excluded from the existing CoCo pricing models.

- The “liaison” between the traditional Jensen’s Agency Costs theory and the Bail-in-driven banking agency costs using indifference curves under both Bail-out and Bail-in rescue scenarios.
- The modelling of covenants inclusion within the CoCos as well as a CAPM-based WACC analysis on the banks post Bail-in to demonstrates the merits of the former and the consequences of the latter on the real economy.

In summary, we conduct a comprehensive assessment of the agency costs arising from Bail-in and CoCos both conceptually and analytically which we believe it is more thorough, detailed and thoughtful than that of the existing literature. Moreover, we aim to address the problem by proposing original solutions which, we believe, will lead to a mitigation of the underlying problems of the new banks’ capital regulation. The problem had been partially identified but not tackled. This thesis completely identifies the problem and also puts in regulators hands practical solutions to avert a potential agency cost related banking crisis in the foreseeable future.

Chapter 2

Literature Review

This thesis rests upon a vast number of well-established academic research on agency costs in general and in banking in particular that underpins some of our theoretical postulates and modelling.

First, we draw upon the theoretical literature on the link between capital structure and equityholders' incentives to build our optimal volatility model that supports our thesis that Bail-in and CoCos lead to higher perverse incentives than Bail-Out. This relation was initially proposed by Jensen and Meckling (1976) and Myers (1977). According to Jensen and Meckling (1976) equityholders of a levered firm have an incentive to augment risk. This is because they effectively hold a call option on the company's assets. This is the so-called risk shifting/overinvestment problem in which shareholders have the incentive to take on risk given their limited investment in the firm. Hence, the risk/reward is always positively skewed to the latter. The risk shifting problem is even more acute in the financial sector given the limited amount of equity relative to debt (the leverage effect) and the systemic risk posed by a financially "distressed" bank. This is the reason why "gambling for resurrection" in a bank during times of crisis usually arises (Dewatripont and Tirole (1994)) since the regulator has usually rescued the bank to safeguard the system. This and other Agency Cost theories are discussed in more detail in Chapter 3.

Second, the agency cost theory also rests upon the long lasting literature on the safety net of banks ((Buser, Chen, and Kane (1981); Calomiris (1991); Honohan and Klinge-

biel (2003)). This theory explains that provided that there are guarantees in place to ensure depositors' money, explicit insurance aims to eliminate the threat of depositor runs and to protect depositors from losing their savings. Nevertheless, it reduces the monitoring incentives for depositors to police their banks. As a matter of fact, Demirgu - Kunt and Huizinga (1999) provide empirical evidence that deposit insurance leads to a trade-off between the benefits of heightened depositor safety and the costs of diminished creditor discipline to conclude that the success of an explicit deposit insurance hinges on a sound regulatory scheme to prevent instability and foster financial development. Moreover, Hovakimian, Kane and Laeven (2002) conduct an empirical research to investigate the effectiveness of government control on banks' overinvestment incentives to conclude that the latter can be mitigated if the country has loss sharing rules, risk sensitive premium and coverage limits in place. We focus very much on the incentive for monitoring in Chapter 5 on the basis of these papers. Furthermore, it is this lack of monitoring from depositors but especially bondholders (pre Basel III, unsecured bondholders were also implicitly protected) that has somehow encouraged the regulator to come up with ways to force bondholders (and to a lesser unsecured deposits, those with deposits above €100,000, that could also face losses) to monitor the banks ("Bail-in" provisions/CoCos) to keep risk in check. If they fail to do so and the bank runs in financial trouble, they will face losses during the normal course of the bank. Last but not least, it is imperative to mention the contribution from Merton (1977) who sets out the foundations for measuring the value of the deposit insurance as a put option on the value of the bank's assets whose analytical framework this thesis heavily relies on.

Third, the disciplinary role of franchise/charter value has also been in the cornerstone of the academic literature on agency costs and we have obviously relied upon. This theory explains that franchise value (Demsetz, Saindenberg and Strahan, 1996) - the present value of the stream of profits that a firm is expected to earn as a going concern - alleviates the regulator's job by decreasing the bank's incentives to run risk. Banks with high franchise value lose more as risky investments are undertaken that lowers the value of the banks and could lead the bank into insolvency. We use this theory in Chapter 5 to analytically demonstrate that Bail-In somehow erodes the franchise value as the bank's solvency moves closer to the CoCo or PONV (Point of Non Viability) trigger due to the

intrinsic DAPR (Deviation from the Absolute Priority Rule) stemming from the Bail-In provisions.

Fourth, we delve into the vast body of academic literature on Bail-in and CoCos (Contingent Convertible) in particular. The concept of CoCo, first proposed by Flannery (2002), has since been supported by several authors (Duffie (2010) and Squam Lake Working Group on Financial Regulation (2009), Pennacchi, Vermaelen, and Wolff (2012), Glasserman and Nouri (2012a), Albul, Jaffee, and Tchistyi (2013), Sundaresan and Wang (2015), Posner (2010), Pennacchi (2011)). No one has been more vocal in promoting CoCos in the banks' balance sheets than Flannery (2014) who undertakes a thorough literature review of the CoCo and related topics and argues that regulatory capital should include more CoCo bonds to partially replace common equity. Navigating through these papers one realizes that the concept has evolved enormously since its introduction but still preserves its main duty: exert bank's monitoring efforts on bondholders and take losses whilst the bank still remains as a going concern.

We believe it is worth spending some words on the numerous papers that have been published that proposes new CoCo structures that significantly differ from the existing one (the CoCo as it stands now has an accountancy-based trigger set at 5% or 7% Core Tier 1 ratio). Sundaresan and Wang (2010) show that in cases in which conversion is triggered by market values falling below a certain threshold, CoCo bonds generally do not lead to a unique equilibrium for equity and CoCo bond prices. The main shortcoming of this proposal is that multiple equilibria can cause problems because market participants might try to manipulate prices to achieve the optimal equilibrium for their holdings (Hillion and Vermaelen (2004)). Glasserman and Nouri (2012) show that the possibility of multiple equilibria can be ruled out in cases in which the triggering security is continuously traded and the conversion price is sufficiently low. Calomiris and Herring (2013) provide a similar design feature which allows for market-based triggers and still preserves a unique equilibrium. Coffee (2010) also proposes that CoCo bonds should not convert to equity, but to preferred stock with cumulative dividends and voting rights. Thereby, a class of shareholders is created which is rationally risk averse. Bolton and Samama (2012) suggest a CoCo with an option to convert whereby the bank issue a "reverse" convertible bond and decides

whether to convert bond into equity somehow allowing the CoCo investors to deal with the counterparty risk by collateralising the put with cash. Chen, Glasserman et al. (2015) studies the design of CoCo bonds and their incentive effects in a structural model with endogenous default, debt rollover, and tail risk in the form of downward jumps in asset value. The analysis shows that once a firm issues CoCo, the shareholders' optimal bankruptcy boundary can be at one of two levels: a lower level with a lower default risk or a higher level at which default precedes conversion. Bulow and Klemperer (2013) introduce the concept of ERNs (Equity Recourse Notes) to replace CoCos that gradually bail in when needed. ERNs would be long-term bonds with the feature that any interest or principal payable on a date when the stock price is lower than a pre-specified price would be paid in stock at that pre-specified price. McDonald (2013) proposes a form of contingent capital for financial institutions that converts from debt to equity if two conditions are met: the firm's stock price is at or below a trigger value and the value of a financial institutions index is also at or below a trigger value. He argues that this structure protects banks during a crisis, when all are performing badly, but during normal times permits a bank performing badly to go bankrupt. Pennacchi, Vermaelen, and Wolff (2012) have proposed a new form of contingent capital, labelled "Call Option Enhanced Reverse Convertibles" (COERCs), which eliminate concerns about a loss spiral. The authors also analyses the effect of COERCs on risk-taking incentives. All these papers are very different and somehow propose ideas to improve the existing CoCos structures away from accountancy-based loss absorption triggers, but fail to deliver one that seeks to address the inherent problem of the CoCo instrument. That is, the augmentation of the perverse incentives of shareholders. In the contrary, we propose an innovative practical solution named CEB (Contingent Equity Base) that aims to fully remove both the agency costs and the moral hazard stemming from Bail-in by fully diluting shareholders but preserving contingent capital in the bank's balance sheet at all times.

The thesis focuses on the agency costs between shareholders and bondholders under the new banks' capital regulation. It does not address however the traditional principal-agent agency cost problem which we also believe it lurks behind the new CoCo bond. Flannery (2009) notes that "we must take care that the conversion process does not influence managers to behave in a counter-productive way". This acknowledges the two-sided effects

on banks: first, CoCo bonds can help recapitalizing a bank in times of distress. Second, the existence of CoCo bonds themselves can possibly change the way managers behave even before conversion. Flannery (2002, 2009), Maes and Schoutens (2010), Coffee (2010) and Hilscher and Raviv (2011) all recognize that the resulting bank managers' incentives should be taken into account. Hilscher and Raviv (2011) show that appropriately designed CoCo bonds are able to cancel out adverse effects of equity-based compensation. In fact, Bailly & Campbell (2013) argue that systemically important financial institutions be required to issue contingent convertible debt (CoCos) and to hold back a substantial share – as much as 20% – of the compensation of employees who can have a meaningful impact on the survival of the firm. Banks, such as Credit Suisse, have paid bonuses to managers in the form of CoCos to align principal and agency interests. A topic worth studying and we will endeavour to do so in subsequent papers.

There are some other papers that touch upon some topics which we have found very helpful throughout the course of this thesis. To name a few, Song and Yang (2016) argues that the CoCo decreases bankruptcy risk and increases the issuing bank value. Wilkens and Bethke (2014) focused on CoCo pricing to conclude that, based on the analysis of the outstanding CoCos, equity derivatives are the most promising approach for the pricing and risk management of CoCo bonds. Finally, Ammann, Ehmann and Blickle (2015) conduct an empirical analysis on the stock and CDS spread reaction before and after the CoCo announcement date to conclude that there is a positive abnormal stock return and negative CDS spread changes after the bond issuance. Fifth, Koziol and Lawrenz (2012) were the first to point out to the asset substitution problem associated with contingent capital when managers endogenously chose the optimal level of contingent capital. This paper has been one of the mainstays of this thesis since it has allowed us to deepen this problem in a more genuine and analytical way. However, not only do CoCos bring about wealth transfer but also value destruction. They also augment the unfair treatment for bondholders (the “NADES”) since the inception of the CoCo that looms large over the life of the contract. This is one of our main contributions relative to the remarkable paper from Koziol and Lawrenz.

Finally, we would like to recognize the contribution from Berg and Kaserer (2011)

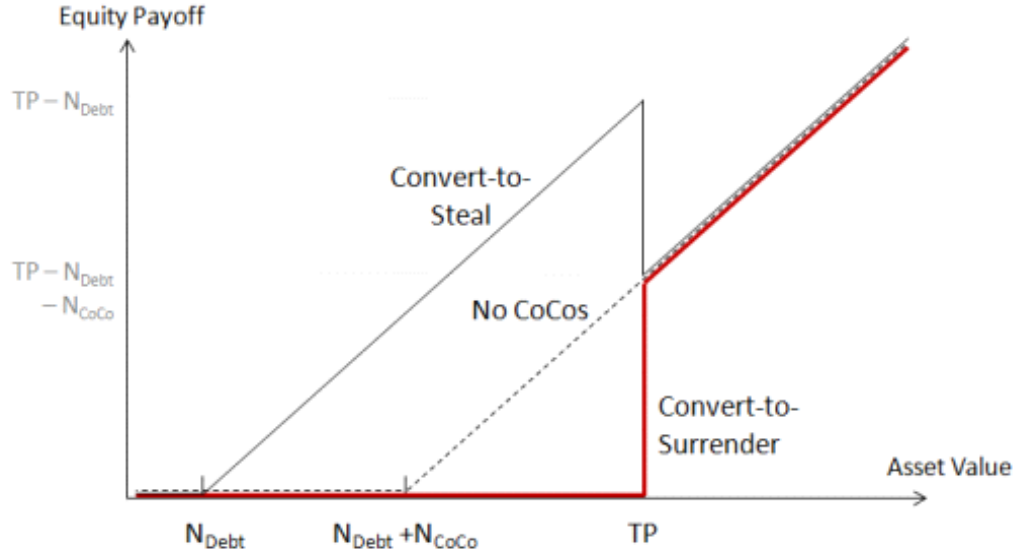


Figure 2.1: Equity Payoff; Source: Berg and Kaserer (2011)

to this thesis whose CoCo modelling has been our starting point, although very different from ours as explained later on. Their revolutionary paper demonstrates that CoCo bonds exacerbate the asset substitution problem in cases in which the conversion price is set too high (the number of shares that the CoCo bond holders receive upon conversion is very low). They show that with a high conversion price a wealth transfer from CoCo bond holders to equity holders takes place at the time of conversion. Roughly speaking, equity holders have to bear the initial losses up to an amount of X . They can impose part of the losses on CoCo bond holders once losses exceed X . Equity holders are therefore better off when being directly below the trigger point rather than being directly above the trigger point. They fully participate in any increases in asset value, while they can impose part of the losses in case of a decrease in asset value. This payoff profile induces destabilizing effects: Bank owners have an increased incentive to take excessive risks if the level of risk is non-contractible (asset substitution) and they have a disincentive to raise new equity in a crisis (debt overhang).

They derive expressions for “Convert to- surrender CoCo” and “Convert-to-steal

CoCo” (see graph below) which are essentially the Equity Conversion and the Writedown CoCo bonds investigated in Chapter 5. However they assume immediate full conversion of the bonds and also allow for multiple equilibrium which differ vastly from our modelling. Below, we highlight some of the main differences between their approach and ours:

- We focus on both value destruction and wealth transfer as opposed to just the former.
- We allow for partial conversion (which is more realistic if losses are smaller than the amount of CoCo bond) and APR (Absolute Priority rule) restoration.
- We come up with a Condor structure for the CoCo that better illustrates the payoff for the equityholders once the DAPR (via bear and bull spreads) are built into the model to accentuate the wealth transfer from bondholders to shareholders.
- We show in later chapters how the outcome differs (relative to theirs) once the DAPR continues after the initial CoCo loss (and hence other unsecured creditors are impaired before the entire equity is fully consumed).
- We focus, using indifference curves, on the effect of the vega under several Bail-In (CoCo) and Bail-out/Expropriation to prove that value destruction is the highest under the former.
- We highlight the detrimental effect of the NADES (Non Admissible Debt to Equity Swap) of the CoCo bonds as bondholders enter into a restructuring (either “equitized” or written down/off”) with no “say” whatsoever given the preset terms of the contract at inception¹.
- We model the optimal volatility of shareholders to reach the highest indifference curve in a pair between franchise value and volatility under a Markowitz type of set-up and we incorporate the monitoring cost that shifts the indifference curve down to discourage shareholders’ risk appetite.

¹As opposed to the traditional corporate restructuring proceeding such as Chapter 11 in which bondholders have a "say" during the restructuring proceeding along with equityholders.

All these papers are just a selection of the prolific emersion of academic interest in the CoCo bond over the recent years. However, it is not just the CoCo bond that gives rise to perverse incentives. The whole Bail-in provisions, which include CoCo bonds, exacerbate these incentives. So we aim to address this problem in a more comprehensive way.

Chapter 3

Agency Cost Theories

In general a firm is supposed to have an indefinite life and is just a legal fiction that serves the contract between different stakeholders, the three most important ones being equityholders (principal), management (agent) and bondholders. (Jensen and Meckling (1976), Smith and Warner (1979)). If both agents and principals are utility “maximizers”, the former will probably not act in the best interest of the latter (through both pecuniary and non-pecuniary benefits) giving rise to agency costs between both stakeholders. The same applies if bondholders’ interests are “sidelined” by the maximisation-based utility function of equityholders. If bondholders did not monitor equityholders’ behaviour, the latter could attempt to use this borrowed money to pay out dividends or increase risk taking leading to bondholders’ debt being extracted to the equityholders’ own benefit (Black (1976), Jensen and Meckling (1976)). Consequently a conflict between these two key stakeholders could arise and cause an aggravation of the relationship. If bondholders were confident that equityholders would not attempt to extract their wealth from, there would be no conflict and no contractual agreement between the firm, equityholders and bondholders. However, this is not the case and debt agreements (and most of the time accompanied by strict covenants) are commonplace in the debt capital markets.

Overall, bondholders and equityholders have conflicting interests regarding dividend, investment and financing policies. To alleviate these conflicts, bondholders resort to a wide array of restrictions and constraints on management (which are acting on behalf of

equityholders) to avoid discretionary investments and financing decisions, leading to the so called agency costs. These are divided into three categories:

- Monitoring costs: as stakeholders ensure that management look after their interests instead of pursuing their own objectives.
- Bonding costs: as the management is more prone to satisfy obligations towards the equityholders. Any deviation is assessed under the standard agent/principal agency cost model.
- Residual Loss: consequently of the constraints imposed to management, profitability can be reduced.

Agency costs are real and burdensome (from both an economical and operational point of view) and should not be ignored by stakeholders (Jensen and Meckling 1976). The level of agency costs varies across firms and depends on how much the principal trusts the agent¹.

3.1 Conflicts Between Equityholders and Management – The Principal Agent Problem

Conflicts between ownership and control (or between equityholders and management) were first studied by Jensen and Meckling (1976). So long as managers are not owners of the firm or they just hold a minority stake, their interests in the firm deviate from those of the principal and can bring about agency costs². The agency problem here rests on the potential interest misalignment between equityholders and managers as the latter pursue its own objectives at the expense of the former's interests. Jensen's (1986) overinvestment problem is an illustrative case of this conflict. Overall management are encouraged to grow the firm above its optimal size and be remunerated according to ROE

¹Highly geared companies are more likely to undergo financial stress and therefore run higher agency costs.

²Such as the consumption of perquisites which are not or just partially borne by management (Aber de Jong (2002)).

or ROAs³. This remunerations scheme can prompt management to take on projects with negative NPV especially when there is too much free cash flow (FCF) and minimal growth opportunities. Nonetheless there are several way to dampen these agency costs such as making management total salary dependent on the firm's performance (stock options) or putting internal (board monitoring, banks, etc.) or external (takeover market - (Demset et al (1995))) control mechanisms in place that can mitigate this overinvestment appetite of management. Sometimes, if managers face wealth loss, reputation risks or firing, they may become more risk averse and reduce risk taking bringing down the agency costs between principal and agent.

To address the typical principal-agent cost problem, two approaches are suggested:

- Refraining approach: there are several theories that dwell on this approach: an increase in leverage would help mitigate management related agency costs since they feel constrained by the legal obligation of paying back principal and servicing interests (Kester, Gul and Tsui, 1986); others such as Shleifer and Vishny (1991) argues that the corporate takeover market will act as a deterrent for shirking behaviour and perks consumption by management. Moreover, authors such as Crutchley and Hansen (1989) suggest that management should pay out/stock repurchase all the idle FCF (Free Cash Flows) to avoid inefficient expenditures.
- Encouraging Approach: several authors such as Lehn and Poulsen (1989) or Dial and Murphy (1990) suggest that the increase of shares holdings by management helps to better align interests and mitigate wasteful FCF allocations.

3.2 Conflicts Between Equityholders and Bondholders – The Wealth Transfer Problem

According to the efficient-market hypothesis, tensions between equity and bondholders is one of the main agency costs in the capital markets. Rational bondholders and equityholders are aware of the incentives that the latter have to extract wealth from the

³Return on Equity and Assets respectively.

former when a new debt security (a bond for example) is issued in the capital markets. Therefore, bondholders assess the financing, dividend, and investment policy at equityholders' disposal and incorporate the wealth extraction into the market price of the bond. What bondholders pay in this first bond is low compared with the successive bonds issuance due to the potential wealth transfer that may occur in the future. At the same time, the firm value grows at the time of the debt issue as the market anticipates a potential wealth transfer from bondholders to equityholders (Smith and Warner (1979)).

3.2.1 Dividend Payment Problem

Firms are more inclined to pay out dividends instead of reinvesting profits to boost the firm's value (Smith and Warner (1979)). According to Black (1976), all dividends which are not matched by similar increase in external financing, are bad for creditors as these assets are not available any longer to pay back bondholders. As management know that equityholders expect dividends and stock repurchases to boost their Internal Rate of Return (IRR) and, as they are acting in their best interest, they pay out dividends using profits (or free cash flow) instead of reinvesting it to maximize the firm's value in the future (as this potential new cash flow could end up in creditors' hands). By using dividends restrictions, bondholders can restrict dividends payouts to equityholders, especially if the firm is experiencing financial distress as management would have the incentive to use the little cash left to meet equityholders' expectations instead of paying down debt.

3.2.2 Underinvestment / Debt Overhang Problem

Equityholders reject positive NPV projects if they feel these profits will be used to pay back creditors. The debt overhang is more likely to occur in financial distress companies since the positive NPV projects-related cash flows will accrue to bondholders first when a default is imminent due to the limited equityholders' liability (Bodie and Taggart (1978)). The underinvestment problem is thoroughly studied by Myers (1977) who argues that the value of the firm rests on both the value of the assets and the NPV of future investments and growth opportunities. This conflict between the asset in place (book value) and the NPV of the future growth opportunities (stock market value) underscores the debt overhang

problem, especially in financially distressed companies.

3.2.3 Overinvestment / Risk Shifting / Asset Substitution Problem

Bondholders' wealth can be extracted by equityholders by participating in new risky projects (even with negative NPV) or shifting from conservative to highly risky investments. This type of projects raises the variance of the firm's value. If the project is successful, the extra gains are captured by equityholders, whereas if it failed, bondholders bear the cost by increasing firm's default. Bondholders can limit this discretionary behaviour by management acting on behalf of equityholders by limiting the holding of financial assets, investment in intangibles or "capping" the maximum leverage in the debt agreements (Nash (2003)). This problem is very common in financially distressed companies where equityholders' claim are "deep out of the money" and they have just one chance to invest the little cash available (which should be utilized to pay down creditors' debt) to survive ("gamble for resurrection").

3.2.4 Claim Dilution Problem

This problem lies on the seniority of the creditor's claims should the firm be liquidated. Bondholders run the risk of being subordinated should new debt be added into the capital structure. If bondholders did not factor this contingency into the price of the bond, wealth is extracted from bondholders. Moreover, if new debt commands a higher priority within the pecking order, the old bond is subordinated and its value sharply reduced (Brauer (1983)). Bondholders usually resort to covenants in the form of negative pledge clauses or debt restrictions to avoid the claim dilution problem (Nikolaev (2001), Begley and Feltham (1999)).

3.3 Agency Costs Under the New Banks' Capital Regulation

The new banks' capital regulation has given rise to agency costs between shareholders and bondholders due to the breach of the Absolute Priority Rule. There is already literature on this topic (Berg and Kaserer (2015), Pennacchi (2010), Albul and Jaffee (2013),

Sundaresan (2010), Koziol and Laurenz (2012) to name a few) that aims to explore the over-investment risk in the new CoCo bonds. Our contribution to the academic literature on this topic ranges from exploring these structure more comprehensively, dwelling on the microeconomics consequences of the introduction of CoCos and Bail-in in general to offering solutions to dampen the looming agency costs and the aggravation of the moral hazard. We will discuss all this in depth in subsequent chapters.

Chapter 4

Overview of the Bank's Capital Structure Under Basel II and III

Banks play a key role in any economy as the provider for the necessary financial intermediation by mobilizing savings from surplus units to shortage ones (in other words from savers to borrowers) with the purpose of funding productive activities at low transaction costs. Over the last century, all the banking system failures were dealt with by the Lender of Last Resort facility (LOLR) and the deposit insurance. The worldwide banking liberalization that came about throughout the last century prompted excessive leverage, diversification, bank maturity transformation and lending standard relaxation (coupled with intricate financial instruments) that put the financial system at risk several times (Mink (2011)). Banks, by

- Gearing up their balance sheets from 2x (Equity/Assets) to more than 30x , a small fall in the asset value could deplete all the equity and render them insolvent.
- Diversifying their portfolio¹ , they reduce their exposure to idiosyncratic risks and become systemic entities which are exposed to a collective bank failure. Cross holdings via equity stakes or bonds accentuate the linkage between domestic and international banks.

¹The removal of Glass Steagall act after Citigroup merged with Travelers enabled big retail banks acquired/merged with investment banks making the banking system more systemic than it was already.

- Embarking on maturity transformation, they fund long-term assets with short term-debt exposing them to deposit runs and a liquidity shortfall.
- Relaxing lending standards, they foster credit bubbles that once “popped”, could set off credit crunches as it happened in 2008.
- Originating intricate financial products (CDS, CDOs² etc.) and forming an esoteric web of different counterparties that discourage monitoring as nobody knew who was bearing the ultimate risk.

Prudential regulation via binding capital and liquidity requirements was suggested as a mean to protect the financial system, minimize the risks stemming from the five aforementioned issues and do away with the intrinsic moral hazard within the system. Prudential regulation had two main objectives and challenges (Acharya (2009)):

- Micro-prudential regulation: attempts to avoid excessive risk taking at the individual bank. It seeks to keep the risk taking incentives of a bank down and alleviate the agency costs that arise in a bank due to the limited liability of equityholders.
- Macro-prudential regulation: aims to minimize the systemic risk that arises when banks are overly exposed to a general failure. It encompasses events such systemic liquidity and capital shortages, deposit runs, fire sales etc. It also evaluates how regulatory capital, bailouts or LOLR (lender of last resort) can minimize or attenuate these unforeseeable events.

The banks prudential regulation continues to be articulated through the Basel II rules even though Basel III rules are being implemented. Basel III has already published several guidelines whose rules are underway that establish the primary rules for the capital structure of banks and the achievement of minimum solvency and liquidity ratios.

²Credit Default Swaps and Collateralised Debt Obligations.

4.1 Overview of the Basel II Capital Structure

Basel II (B2) remains the prevalent regulatory framework. However Basel III (B3) is taking hold now on a phase in mode meaning that banks will have to abide going forward by B3 measures throughout the implementation period (2016-2022).

Under B2, there are four types of regulatory capital ratios, namely Core Tier 1, Tier 1, Tier 2 (Upper and Lower) and Tier 3 or Total Capital ratio. We describe briefly each capital layer to understand the nature of the solvency ratios.

- Core Tier Equity or Core Tier 1 (CT1): It is the purest equity layer in the capital structure. It is made up of the ordinary equityholders' equity + retained earnings + reserves and share premium account + available for sale reserves (AFS) + minorities.
- Tier 1 (T1): CT1 + perpetual non-cumulative preferred stock / bonds (known as "Tier 1"). The main characteristics of T1 bonds are:
 - Perpetual and senior only to equity.
 - Coupons are deferrable and non-cumulative.
 - Interests and principal can be written down.
- Tier 2 (T2): T1 + perpetual deferrable subordinated debt (Upper Tier 2 bonds-UT2) + revaluation reserves from fixed assets and fixed asset investments + general provisions up to a maximum of 1.25% of risk weighted assets + dated subordinated debt with a minimum maturity of five years (Lower Tier 2 bonds-LT2) + any perpetual debt with no loss absorbency features or interest deferral provision. Tier II cannot exceed 50% of Tier I (and hence Tier II < Tier I). The main features of the UT2 and LT2 are:
 - UT2:
 - * Perpetual and senior to Tier 1 and equity.
 - * Coupons are deferrable and cumulative.
 - * Interests and principal can be written down.

- LT2:
 - * Subordinated only to senior debt.
 - * No deferral of coupons and no write down of principal and interest.
 - * Dated with minimum maturity of 5 years.
- Tier 3 (T3): T1 + T2 + dated subordinated debt with a minimum of two years.

The main characteristics of T3 are:

- * Dated with a minimum maturity of 2 years.
 - * Rank pari passu with LT2.
 - * Both interest and principal can be deferred due to regulatory “lock in” clause if the capital ratios fall below a threshold.
- Capital ratio (BIS ratio) is the overall capital ratio and is the sum of CT1+T1+T2+T3.

Banks must make some deductions to their total levels of capital to avoid regulatory pitfalls such as double counting of capital (Morgan Stanley 2010). The main deductions are:

- CT1 and T1: goodwill and intangibles; treasury stock.
- T2: investments in unconsolidated subsidiaries and associates; connected lending of a capital nature, including guarantees; all holdings of another bank’s capital over a maximum of the equivalent of 10% of a bank’s eligible Tier 1 and Tier 2 capital base.

The solvency ratios are set as a ratio of capital to risk weighted assets (RWA). The RWA scales the notional of the risk position. It is intended to proxy the riskiness of the underlying position. The RWAs are computed in three components (the so called “three pillars”):

- Credit risk: capital held against the risk of entity specific losses on positions (equities and credit) held in the banking book and the counterparty (CP) risk.
- Market risk: risk of losses arising from movements in the market prices of positions held in the trading book.

- Operational risk: capital held against the risk from failed internal processes, people, systems, or external events.

The capital ratio defines how much capital has to back each unit of RWA. Under current B2 regulations, the capital ratio is set at 8% and the majority of this capital (at least 4%) must be T1 capital. These ratios just represent the regulatory minimum. In reality, banks usually manage much higher ratios .

B2 capital ratios have proven to be weak to withstand big shocks and keep the banks as going concern in the event of mounting losses that wipe out the equity. This weakness has been highlighted by the crisis. The main flaws of B2 are:

- Capital base too small and Tier 1/2 bonds have not proven to be loss-absorbing. Ultimately LOLR has been drawn in to prop up the system.
- Pro-cyclicality of the economic cycle not addressed.
- Systemic risk not appropriately captured.
- Significant jurisdictional differences exist in the capital definition.

To address some of these issues and minimize the failure of the banking system that could trigger another recession, B2 rules have been enhanced and overhauled and B3 will be the new regulatory framework as described in detail below.

4.2 Overview of the Basel III Capital Structure

B3 is an innovative regulatory scheme that touches upon three main dimensions: capital, liquidity and balance sheet duration. The first aims to bolster capital levels in the system by increasing equity requirements (and hence lowering leverage) and rendering the capital structure loss-absorbing by forcing the unsecured debt to include loss absorption clauses upon regulatory triggers. The new second seeks to avoid liquidity shortages in the short-term by forcing banks to hold very short-term liquid assets. The third attempts to achieve a better balance sheet matching by requiring banks to issue long-term liabilities to

fund long-term assets. All in all, a comprehensive regulatory framework has been put in place in order to minimize the risk of an overall financial meltdown and avoid the LOLR intervention (Bail-out), dampen the intrinsic moral hazard in the system, and render private investors liable for the losses of the bank (Bail-in).

B3 recalibrates to three capital ratios:

- A minimum common equity (CT1) ratio of 4.5%.
- A minimum Tier 1 capital ratio (T1) of 6%.
- A minimum total capital ratio (BIS) of 8%.

However these ratios will come in at higher levels due to additional buffers, further domestic regulatory rules and the status of Too Big To Fail (TBTF) that could bring the Fully Loaded Core Tier 1 up to 11% for TBTF

The new B3 rules aim to:

- Dampen cyclicalities by building up capital buffers (the "capital conservation buffer") in periods of growth.
- Protect the banking sector from periods of excess credit growth.
- Potential additional benefit moderating loan growth during bubbles.
- Decreased systematic risk in the banking system.
- Build-up capital buffers before distributed earnings.
- Make the capital structure more loss-absorbing / "Bail-in" oriented to avoid the LOLR and taxpayer's money.

B3 facilitates a transition period so that banks can implement the necessary measures to comply with the new rules. B3 will give time for banks to shore up their equity ratios (CT1), to replace the outstanding subordinate bonds for loss-absorbing compliant

ones (with a grandfathering period through 2023 period³), raise sufficient liquid assets and long-term funding to meet the liquidity and duration ratios. Moreover, many fixed income mandates in the asset management world do not allow bonds with equity-linked features so through the extensive B3 phase-in period, investors will be able to customize their investment mandate to hold loss-absorbing bonds⁴ (in other words Bail-in able debt). Figure 4.1 illustrates the "phase-in" nature of the compliance of the compulsory capital ratios to enable the bank to progressively raise capital and bail in able debt.

	2011	2012	2013	2014	2015	2016	2017	2018	As of Jan. 1, 2019
Leverage ratio	Supervisory monitoring		Parallel run: Jan. 1, 2013 – Jan. 1, 2017 Disclosure starts Jan. 1, 2015				Migration to Pillar 1		
Minimum common equity capital ratio			3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
Capital conservation buffer						0.625%	1.25%	1.875%	2.5%
Minimum common equity plus capital conservation buffer			3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
Phase-in of deductions from CET1 (including amounts exceeding the limit for DTAs, MSRs and financials)				20%	40%	60%	80%	100%	100%
Minimum Tier 1 capital			4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
Minimum total capital			8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Minimum total capital plus conservation buffer			8.0%	8.0%	8.0%	8.625%	9.125%	9.875%	10.5%
Capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital			Phased out over 10-year horizon beginning 2013						
Liquidity coverage ratio		Observation period begins			Introduce minimum standard				
Net stable funding ratio		Observation period begins						Introduce minimum standard	

Figure 4.1: B3 Regulatory Framework and Phase In Period ; Source: DB (2011)

Figure 4.2 illustrates the minimum B3 capital ratios (including the buffers) laid out by the Basel Press Release (12 Sep 2010) and the mandatory capital structure issued by the Commission of Experts (FINMA) for the Swiss Banks .

As far as B3 is concerned, the minimum requirement for common equity will be

³Callable bonds with step up coupons will lose all Tier 1/2 eligibility after the first call date. Bullet bonds will be grandfathered unless they have a strong loss absorption language or otherwise the country has in place a resolution regime whereby the regulator has been granted powers to "bail in" bank's liabilities below the PONV.

⁴Either with equity conversion features (CoCos) or write down/off features.

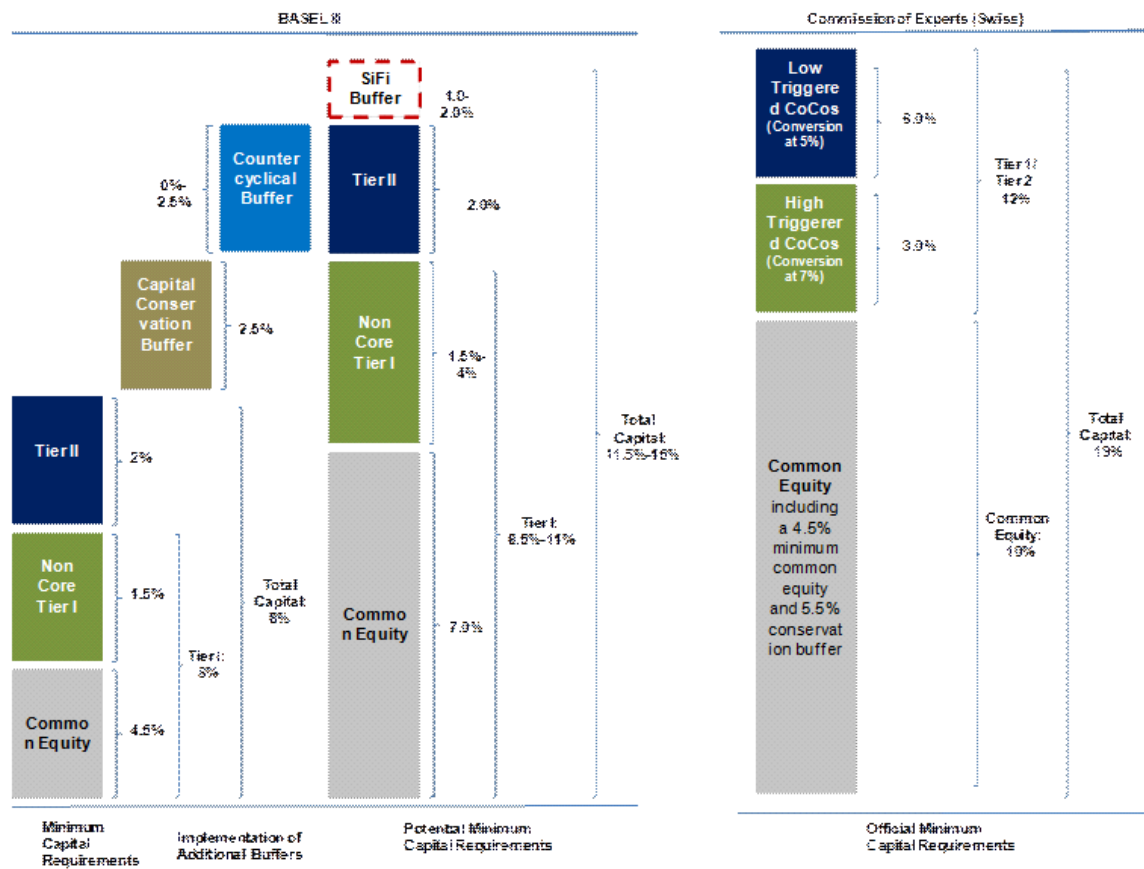


Figure 4.2: B3 and Finma Capital Ratios; Source: Author

raised from the current 2% level, before the application of regulatory adjustments, to 4.5% after the application of stricter adjustments. The T1 capital requirement, which includes common equity and other qualifying financial instruments, will increase from 4% to 6%. The capital conservation buffer above the regulatory minimum requirement should be calibrated at 2.5% and be met with common equity⁵. A countercyclical buffer within a range of 0% – 2.5% of common equity or other fully loss-absorbing capital will be implemented according to national circumstances. This buffer will only be in effect when there is excess credit growth that is resulting in a system wide build-up of risk. The countercyclical buffer, when

⁵Restrict discretionary distributions (dividends and bonuses) when the bank's capital level is close to a minimum.

in effect, would be introduced as an extension of the conservation buffer range. Systemically important banks (SiFi or TBTF) should have loss-absorbing capacity beyond the standards announced. The Basel Committee is developing a well-integrated approach to systemically important financial institutions which could include combinations of capital surcharges, contingent capital and “Bail-in” debt. Therefore, in our estimations, the total capital ratio could go as high as 16%-18% for the main core European banks.

As for FINMA, the Swiss regulator imposes higher requirements than those of B3 due to the “Too Big to Fail” problem given the size of UBS and Credit Suisse’s assets versus the Swiss GDP (600% Assets / GDP) . In summary, the Swiss regime will require the large banks to have a minimum CT1 of 10% (4.5% minimum common equity and 5.5% of conservation buffer). On top of this, the Swiss banks should hold an additional capital cushion of 9.0% of contingent convertible securities (3% of RWAs with a 7% CT1 trigger and 6.0% of RWAs with a 5% CT1 trigger⁶). The total capital ratio amounts to 19%, roughly 400bps higher than the highest potential capital ratio under B3.

B3 has explicitly placed strong emphasis on the core equity relative to the hybrids instruments (even more the Swiss regulator). However, we believe that the hybrids will definitely contribute to meet higher regulatory capital requirements. The introduction of additional buffers to the minimum required capital will increase the importance of the loss-absorbing hybrid instruments in the overall capital structure of the banks. As mentioned above, there are basically three capital buffers set at the discretion of the regulator and in line with the proportion of the bank’s assets relative to the GDP:

- The Capital Conservation buffer (CCB) to build-up capital outside periods of stress that can be drawn upon as losses are incurred.
- The counter cyclical buffer (CCyB) which could be in the region between 0% - 2.5% to build-up in periods of excess credit growth.
- The SIFI (Systematic Important Financial Institutions) between 0% - 2%.

⁶In practice, we would regard the 3.0% of high trigger securities as a form of “going concern” capital and the 6.0% of low trigger securities as a form of “gone concern” capital.

In figure 4.3, we compare three different capital structures namely B2, B3 and Comprehensive B3. The last includes my estimation of the three aforementioned buffers.

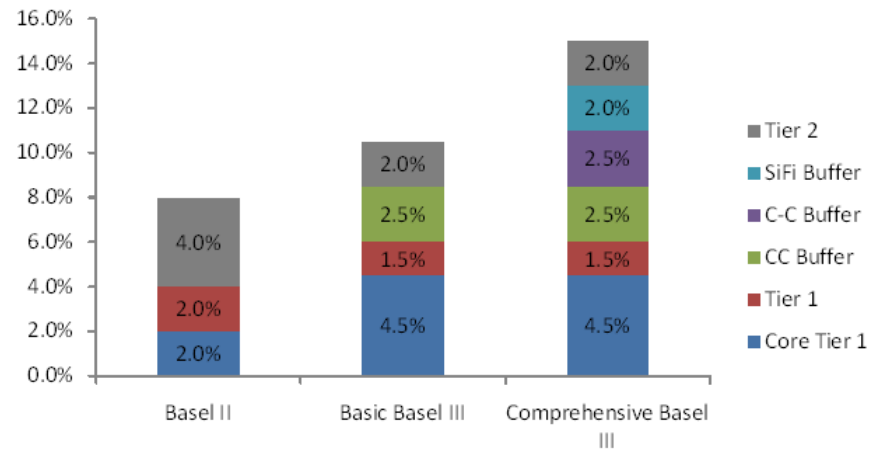


Figure 4.3: Basel Capital Structure Comparison; Source: author

On that basis, the proportion of non-CT1 instruments (effectively B3 compliant instruments) could increase from 33% to 53% by adding loss-absorbing hybrid capital to meet the regulatory buffers. We can observe that despite the proportion of non-Core Tier 1 instruments being lower than the maximum levels of B2 (75%), on absolute terms the 8% level of non-Core Tier 1 would be higher than that of B2.

Therefore and contrary to market perception, the overall amount of hybrids in B3 could much higher than in B2, even though it will depend on the levels of additional buffers imposed by the regulators, as shown in figure 4.4.

<u>Proportion of Basel III compliant instruments</u>						
	Basel II		Basic Basel III		Comprehensive Basel III	
	%	<u>Cost</u>	%	<u>Cost</u>	%	<u>Cost</u>
Core Tier 1	2.0%	25.0%	7.0%	66.7%	7.0%	46.7%
Non Core Tier 1	6.0%	75.0%	3.5%	33.3%	8.0%	53.3%

Figure 4.4: Proportion of B3 Compliant Instruments; Source: author

Figure 4.5 shows a snapshot of the mandatory requirements for Tier 1/2 to be eligible for the B3 capital ratios. As can be observed, loss absorption is one of the main new features.

Going-concern trigger		Gone-concern trigger	
Viable	Non-viable	Non-viable	Insolvent
Early supervisory intervention		Resolution	Liquidation
	Tier 1	Tier 2	
Key Features	Perpetual, no step up Optional coupon cancellation (no pusher but ord div stopper is allowed) Non-cumulative Deeply subordinated	Dated with minimum maturity of 5-years Capital amortised over the last 5-years No coupon deferral Subordinated	
Going Concern	Loss absorption through conversion into equity or principal write-down upon breach of a predefined capital ratio Trigger: local regulator discretion	None (unless if used as a host for going concern contingent capital)	
Gone Concern	Loss absorbing through conversion to equity or principal write down when <ul style="list-style-type: none"> – An institution is judged by its <i>regulator</i> to have reached the <i>point of non-viability</i>, or – The <i>public sector provides capital</i> or equivalent support to restore a failing bank, without which the bank would not be viable Requirement to have this additional loss absorption feature maybe fulfilled <ul style="list-style-type: none"> – By adding a <i>contractual provision</i> in the terms of the instrument, or – As a result of an equivalent mechanism provided by the laws on <i>resolution regime</i> in effect in the issuer's jurisdiction 		

Figure 4.5: Going Concern vs Gone Concern Capital; Source: DB (2011)

In figure 4.6, we can observe that B3 is addressing not only the capital structure and solvency but also leverage and liquidity.

4.2.1 A more detailed description of the capital structure

As explained in previous sections, European banks' capital stack comprises different layers of capital (Figure 4.7):

Pillar 1: 8% compulsory capital ratio for all banks.

- Core Tier 1 (equity): 4.5%

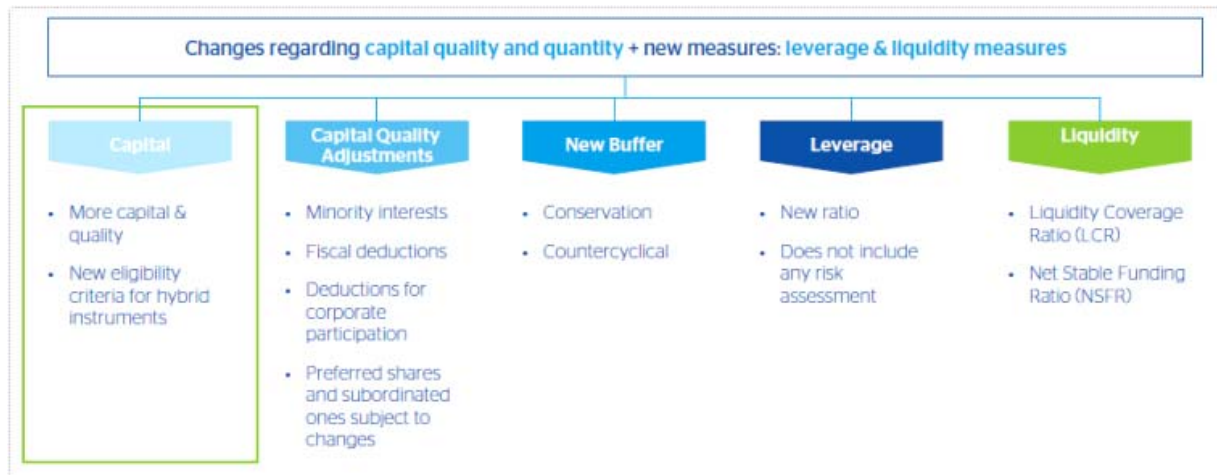


Figure 4.6: Comprehensive B3; Source: DB (2011)

- AT1⁷ (debt) : 1.5%
- Tier 2 (debt): 2%

Combined Buffer: 2.5% to 10% all equity based specific additional buffers.

- Conservation Buffer: 2.5% - same for all banks
- Countercyclical Buffer: [0%-2.5%]
- Systemic Risk Buffer: [0-5%]

Pillar 2: to cover additional capital requirements such as idiosyncratic risk of the banks or future stress test carried out by the regulator.

- Same structure as Pillar 1
- Between 0%-2% RWA;

Management Buffer: at discretion of bank management.

⁷Additional Tier One: the most deeply subordinated Contingent Convertible.

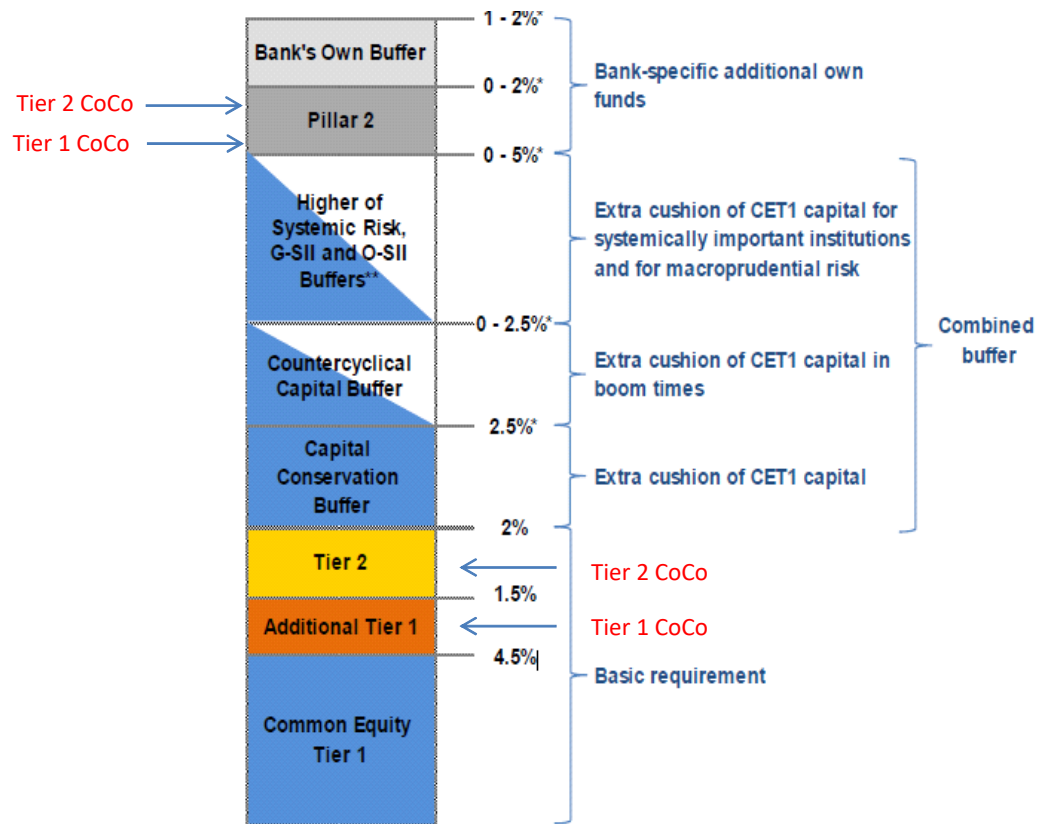


Figure 4.7: Detailed Capital Structure; Source: Citigroup (2015) and author

- 1%-2% to pay dividends, bonuses etc.;
- Maintain healthy cushions above combined buffer to issue CoCo

As we can observe, the overall capital requirement is very onerous with respect to Basel II and will set at around 13%-17% ex TLAC⁸.

The graph also illustrates how the new instrument CoCo plays a role in filling up Pillar 1 and 2 in both Tier 1 and Tier 2 format as contractual - loss absorbing going concern instruments.

⁸Total Loss Absorbing Capacity for banks. Basically, how much equity and loss absorbing instruments the bank's balance sheet has to cope with a restructuring or a resolution. More of this in subsequent chapters. Refer to Chapter 4.7 for an in depth discussion on the topic.

4.3 Bail-in and Contingent Capital Instruments (CoCo Bonds)

The objective of the Bail-in proposal, as a Resolution Regime tool⁹, is to provide a mechanism to restore an insolvent bank by writing down creditors or convert them into equity instead of relying on external capital injection or, in other words, taxpayer money (Bail-out). The underlying reason of this proposal rests on the requirement to avoid a sudden collapse of the financial markets when a big bank fails.

As explained previously, Bail-out (and the deposit guarantee) creates moral hazard due to the limited liability of equityholders who are able to pass losses on to the regulator upon failure. It somehow creates moral hazard across bondholders (bond and loanholders) as they are willing to take on high risky debt (and forego costly monitoring) in search of high yield as they are only exposed to losses should the bank be liquidated (gone concern). Consequently Bail-in regimes aim to deliver the same outcome as any bank insolvency proceeding (Bank Resolution Regime), albeit in a more efficient way without invoking a formal insolvency process which can be lengthy, cumbersome and disruptive (and reduce the inevitable debt overhang that a bank's failure triggers). Bail-in is just another resolution tool that attempts to preserve the bank as a going concern by imposing losses on both equity and debt holders on a going concern basis without the requirement to resort to public funds¹⁰. As we will argue in the following chapters, Bail-in does not alleviate moral hazard (however it may be an aggravating factor) but may increase the agency costs between equityholders and bondholders.

Under the Bail-in regime, liquidation will be contemplated only on non-viable banks or when "going concern" procedures have been exhausted and liquidation is the only available tool.

To impose losses on unsecured debt holders of bank on a going concern basis, two tools are available: Contractual and statutory Bail-in:

⁹Four Resolution Tools and Powers are envisaged in the Draft Crisis Management Directive Proposal by the EC (2012): sale of business, bridge institution, asset separation and Bail-In tool.

¹⁰Bail-in is not a panacea to mitigate the moral hazard problem. Bail-in could work if a bank just fails for idiosyncratic reasons (a bank fails because of its flawed business model). If the failure happens across the entire financial system and bail-in eligible debt is actually held by other banks, Bail-in could increase systemic risk and fail to deliver its ultimate goal: financial stability and tax payers' money protection

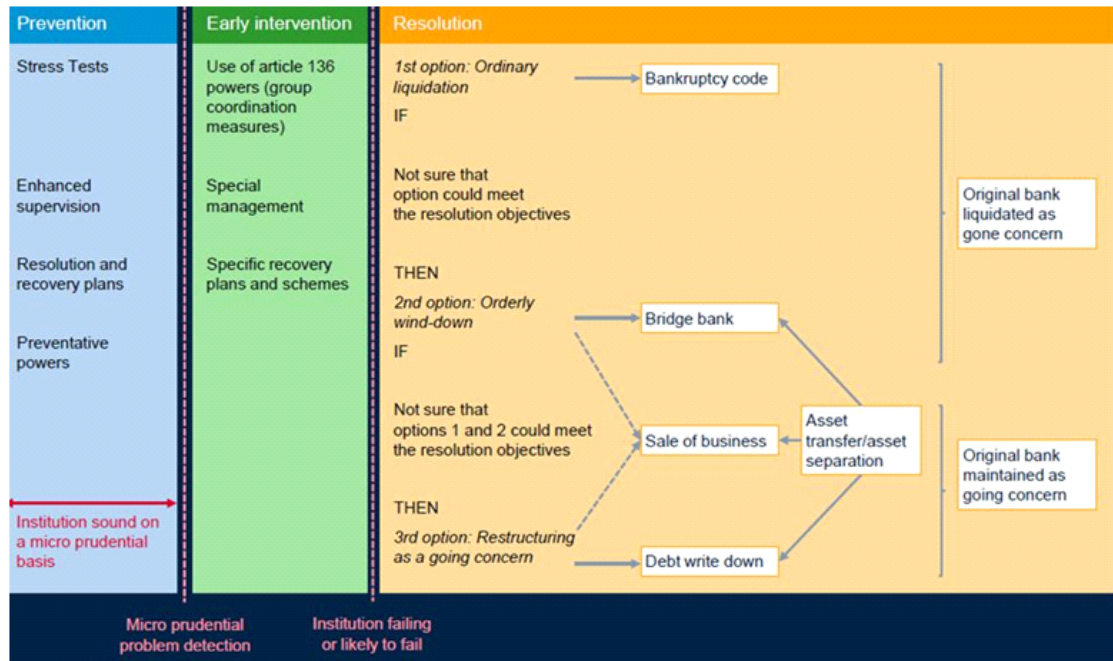


Figure 4.8: EC Discussion on Bail in; Source: DB Advisors (2011)

1. Contingent capital (CoCo) (or Contractual Bail-in)

These are bonds that convert into equity (CoCo) or they are partially/fully written down/off when the capital ratio¹¹ falls below a threshold which is set out in the bond indenture. The trigger point is a going concern trigger¹² which is set in advance and can only be activated upon a breach of the minimum capital ratio.¹³ It does not require regulatory intervention, as the conditions upon which they convert are specifically indicated in the bond documentation, so there is no regulatory discretion to trigger it and share losses with bondholders.

¹¹Usually Core Tier 1.

¹²The bank is just slightly short of capital but still viable and liquid ie. CT1>7%.

¹³However, regulators do have rights to impose losses on bonds even if the trigger are not activated if the bank is deemed to have reached the point of non-viability. This could happen if the CoCo trigger is set at very low capital levels (UBS has issued 5% CT1 trigger CoCo). The regulator will force bank to issue high trigger CoCo (7% CT1) as the low one will be only be triggered when the bank is close to failure. Note that the Swiss regulator has already banned the use of low trigger CoCo within the compulsory capital ratios since they are deemed to be gone concern instruments rather than going concern due to the low level of the trigger. Consequently, Swiss low trigger CoCos will be called at first date.

2. Statutory Bail-in or Resolution Regimes

Regulators want to ensure there is sufficient Bail-in able debt in the capital structure to tackle with an unexpectedly vast amount of losses¹⁴ so that the capital ratios are restored without causing much disruption at both the bank and the system level. Moreover, some banks will not be able to tap the Bail-in able market either because of their small size or the unmanageable cost of funding. Consequently, through statutory powers¹⁵, Bail-in becomes a resolution tool to trigger losses on creditors (even though the bond indenture does not contemplate that) when the regulator thinks the bank is reaching the point of non-viability (PONV). Bail-in envisages a gone concern trigger¹⁶ with going concern goals giving regulators discretion to impose losses on bondholders as no trigger point is set out in advance.

The defining feature of the Bail-in able debt that make them different from any other capital instrument is that they are structured to absorb losses on a going concern basis and thereby recapitalise a weakening bank. At the moment, two types of Bail-in able debt has been issued: CoCos (Contingent Convertible) and Writedown/off featured bonds.

- **Equity Conversion CoCo:** This instruments converts into equity at a pre-set conversion price once the trigger is breached (high or low trigger). These are preferential instruments for debt investors due to some expected recovery value once the share price of the bank recovers overtime. It is nonetheless unattractive for equityholders because of the potential dilution. The main drawbacks are that they introduce complexity to the valuation models, may not be suitable to some investment mandates

¹⁴This figure could hover between 23%-28% RWA for TBTF as confirmed by the recent SREP (Supervisory Review and Evaluation) undertaken by the ECB. This is the so called TLAC (Total Loss Absorbing Capacity) or MREL (Minimum Regulatory Eligible Liabilities set by CDR IV, the European Directive on Banks' capital regulation) of the bank. Unless banks meet this ratio through equity, CoCos and traditional Tier 2, senior debt could become loss absorbing on a going concern basis. The regulator is now evaluating this option and three approaches are considered: contractual (including a loss absorbing clause within the new senior bond indentures); structural (where senior becomes loss absorbing unless there is enough subordinate debt to comply with the TLAC) and statutory (making just senior debt at the holding company loss absorbing and be "downstreamed" to the operating company)

¹⁵Regulator' powers include: reduce/cancel principal amount of debt (up to zero); convert debt into shares; force new share or capital instruments issuance; alter, amend or cancel coupons; replace management; launch a business reorganization plan, etc.

¹⁶As the bank is not viable anymore with such a capital shortage ie. CT1<5%.

that do not allow for equity-linked instruments and can cause some pro-cyclicality from share dilution¹⁷.

- Principal writedown/off: these instruments are written down / off either temporarily or permanently intensifying the expected loss to bondholders since they receive no shares in exchange. These are preferential instruments to equityholders and banks as the former are not exposed to dilution. From an investor's standpoint, it aggravates the Deviation from the Absolute Priority Rule (DAPR) as the recovery rate of bondholders will be zero in some instance, whereas equityholders could recover their initial losses (from the current capital ratios down to the trigger point of the loss-absorbing bond) and dilution once the share price recovers overtime.

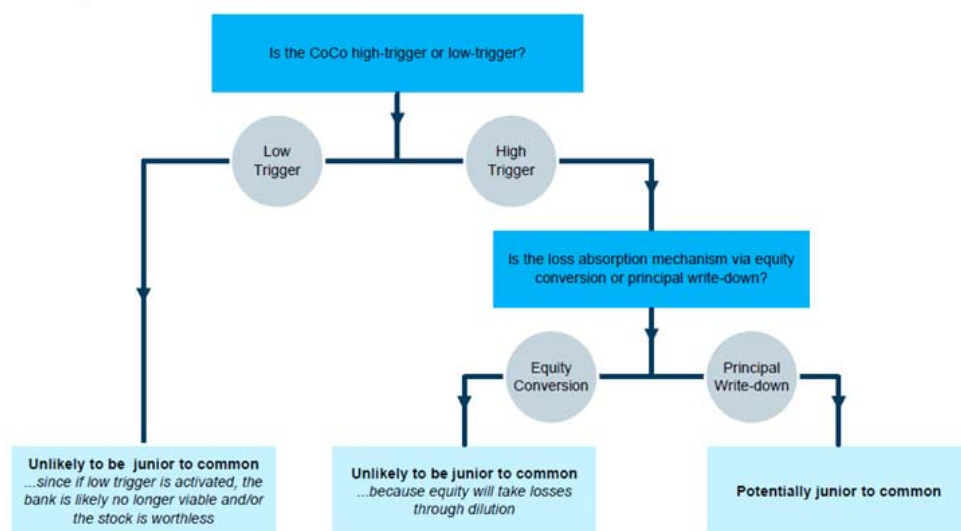


Figure 4.9: Are Bondholders Senior or Junior to Shareholders?; Source: Barclays (2011)

¹⁷If the share price is not preset in advance, the decline in the share price could accelerate as the fundamentals of the bank weaken and solvency ratio move closer to the CT1 trigger leading to further shares to be issued to restore solvency ratios.

4.3.1 In depth discussion on the CoCo

CoCo¹⁸ (Contingent Convertible) is a fixed income instrument dated or undated which is eligible for regulatory capital treatment under Basel III. It can take the form of Tier 1 (perpetual and deeply subordinated with optional coupon payments) or Tier 2 (dated and senior to Tier 1 but subordinated to senior with mandatory coupon payments). CoCo absorbs losses when the solvency of the bank deteriorates either contractually through the bond indenture or statutorily through resolution regimes at the PONV (Point of Non Viability). Under the former, the bond can be converted into equity or written down/off permanently or temporarily should the Core Tier 1 (CT1) of the bank fall below 7% (high trigger) or 5.125% (low trigger) according to the bond trigger level and conversion features. Under the latter, once the Core Tier 1 of the bank falls a level which is deemed to be non-viable for the bank to operate as a going concern, the bond can also be impaired by the regulator in the form of debt to equity swap or writedown/off (for example, should the CoCo has a low trigger and the CT1 falls below the PONV set by the regulator, the CoCo takes losses even though its trigger level has not been breached). Hence, the discretionary power of the regulator to impose losses on CoCo supersedes the contractual loss absorbing features of the bond

Figure 4.10 illustrates the differences between the AT1 and Tier 2 CoCos relative to the legacy ones. As we can observe, there are notable differences between the new and the old structures.

Figure 4.11 shows the criteria that AT1 and Tier 2 (recall that Tier 2 can be in the form of CoCo or plain vanilla Tier 2) should meet for the bonds to be capital eligible for solvency purposes.

Hence, Additional Tier 1 (AT1) debt differs materially from legacy Tier 1 debt in two main areas:

- AT1 coupons must be fully discretionary, and the provisions in the instrument may not stop the institution from recapitalising. In the EU, this has been interpreted as no dividend pushers or stoppers.

¹⁸Refer to Appendix 2 at the end of the thesis for a full summary of the terms of the outstanding Cocos.

AT1: New Vs legacy Tier 1

Feature	AT1	Legacy Tier 1
Term	Perpetual	Perpetual
Call	No less than five years from issue	No less than five years from issue
Step-ups	Not permitted	Max 100bp or half original Libor spread
Coupons	Full issuer discretion	Deferrable under certain conditions
Dividend pushers/ stoppers	Not allowed in EU, yes in Switzerland	Yes
Loss absorption	Write-down or conversion to equity	None usually
Trigger for loss	5.125% CET1 ratio or above	n/a
Write-up	Possible	n/a

Tier 2: New Vs old

Feature	New Tier 2	Legacy Tier 2
Term	Minimum 5 years	Minimum 5 years
Call	No less than 5 years from issue	No less than 5 years from issue
Step-ups	Not allowed	Allowed
Coupons	Non-deferrable	Deferrable & cumulative for UT2 only
Lower & Upper Tier 2	No - just "Tier 2"	Yes
Loss absorption	At the PONV	On liquidation only

Figure 4.10: AT1s & Tier 2 Old and New; Source: AT1 Handbook; Societe Generale (2016)

- AT1 must contain unequivocal loss absorption in the form of nominal write-down or conversion to equity when the institution's Core Tier 1 ratio falls below a certain trigger level.

New Tier 2 (T2) debt differs from legacy Tier 2 debt in two main areas:

- New Tier 2 must be loss-absorbing at the point of non-viability (PONV). This is enshrined in the BRRD¹⁹ and hence applies to all existing and new Tier 2.
- Perpetual cumulative debt, Upper Tier 2 (UT2), no longer has a specific bucket requirement and as such is unlikely to be issued again

Figure 4.12 shows the key features of the outstanding European CoCo market that has rapidly grown and stands at €112bn as at January 2017. These figures includes all CoCos (AT1s and Tier 2) issued by European banks in dollar, sterling and euros. This market now offers yields around 8.3% to call with a duration of around 4 years, so fairly attractive to volatility-friendly investors.

¹⁹Bank Recovery and Resolution Directive.

	Bank Additional Tier 1	Bank Tier 2
Subordination	<ul style="list-style-type: none"> • Deeply subordinated and junior to tier 2 	<ul style="list-style-type: none"> • Subordinated. Junior to senior debt and depositors
Acceleration	<ul style="list-style-type: none"> • Should not contribute to liabilities exceeding assets if such balance sheet test is part of the national solvency test 	<ul style="list-style-type: none"> • Does not contain features that cause or accelerate insolvency
Maturity / redemption	<ul style="list-style-type: none"> • Undated • First contractual opportunity to redeem shall not be before 5 years (subject to exceptions, i.e. tax and regulatory reasons) • Repayment or redemption is subject to prior supervisory approval • Only repayable or redeemable at the option of the issuer 	<ul style="list-style-type: none"> • Dated, usually 5-NC-10 or 10yr bullet • First contractual opportunity to redeem shall not be before 5 years (subject to exceptions, i.e. tax and regulatory reasons) • Regulatory amortisation of capital treatment over the last 5 years to final maturity • Repayment or redemption is subject to prior supervisory approval • Only repayable or redeemable at the option of the issuer
Incentive to redeem	<ul style="list-style-type: none"> • Not permitted 	<ul style="list-style-type: none"> • Not permitted
Coupon payments	<ul style="list-style-type: none"> • Mandatory cancellation of distributions in case of insufficient distributable items / breach of equity capital buffer requirements • Full discretion to cancel distributions • Non-cumulative • No pusher or stopper mechanism permitted 	<ul style="list-style-type: none"> • Mandatory pay coupon (non-payment is a default event) • No coupon deferral
Loss absorption	<ul style="list-style-type: none"> • Principal write-down (temporary or permanent) or conversion into ordinary shares in case CET1 < 5.125% (or higher) • Principal must be written off or converted into equity at the point of non-viability 	<ul style="list-style-type: none"> • Principal must be written off or converted into equity at the point of non-viability
Other	<ul style="list-style-type: none"> • Free from encumbrances • Any redemption (without replacement) may be subject to a higher capital threshold • Does not hinder recapitalisation 	<ul style="list-style-type: none"> • Free from encumbrances

Figure 4.11: AT1s and Tier 2 Description; Source: J.P.Morgan, Solvency II Delegated Acts as of 17 January 2015; CRD and CRR, June 27, 2013 and EBA Final RTS, January 2014

Number of CoCos	151
AT1	137
T2 CoCo	24
Overall Size (Eur bn)	112
Average size (Eur bn)	1.3
Average Coupon	6.2%
Loss Absorption Action	
Equity Conversion	33%
Partial Permanent Write Down	2%
Permanent Write Down	25%
Temporary Write Down	39%
Trigger Point	
<=5.125%	61%
5.125%-7%	35%
>7%	4%
Seniority	
Tier 1	87%
Tier 2	23%
Rating	
Investment Grade	29%
Non Investment Grade	71%
Average Price	96
Average Duration (years)	4
Average yield to call (%)	8.3%
Average yield to perpetuity (%)	7.7%

Figure 4.12: Main CoCo Metrics; Source Bloomberg & author

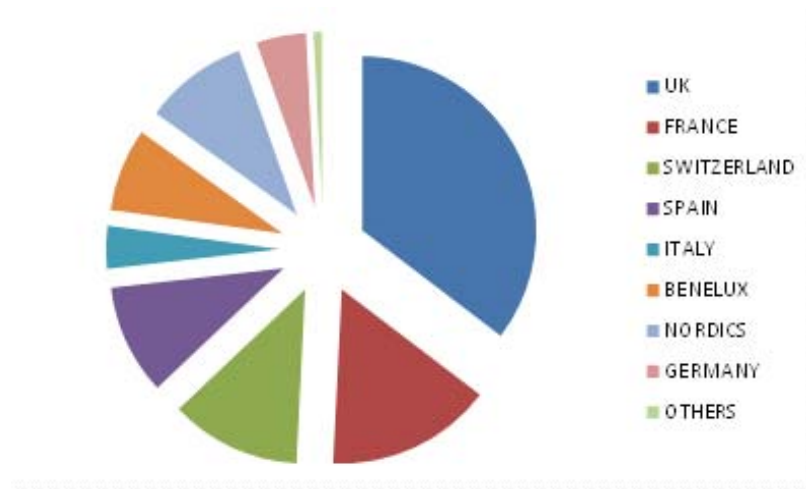


Figure 4.13: CoCo Issuance in Europe; Source: AT1 Handbook; Societe Generale (2016)

Country-wise, Figure 4.13 shows that UK has been the most active CoCo issuing country so far €39bn of issuance, followed by France with €17bn and Switzerland with €13bn.

In terms of outstanding amount per issuer, Figure 4.14 shows a summary of the volume of issue of CoCo from European banks until the end of October 2016. Volumes range between €10bn from HSBC to €4bn from BNP to €87mn from Aldemore Group

In figure 4.15, we can also observe the current CoCo investors base with an overwhelming participation of Asset Managers as opposed to Hedge Funds (that tend to invest in high yield but also volatile investments). The investor base evolution has sharply change since the product inception where Hedge Funds and active investors used to represent the bulk of their investor base. Familiarity with the product, transparency in reporting from the banks as well as the recent support for the product from the regulator have enticed asset managers and passive investors into the product (mention the MDA).

Figure 4.16 illustrates the performance of the absolute return liquid developed market CoCo Index since inception standing now at 15%. Once can appreciate the acute volatility of these instruments as a result of the equity - like features of the CoCos (conversion into equity; coupon suspension etc).

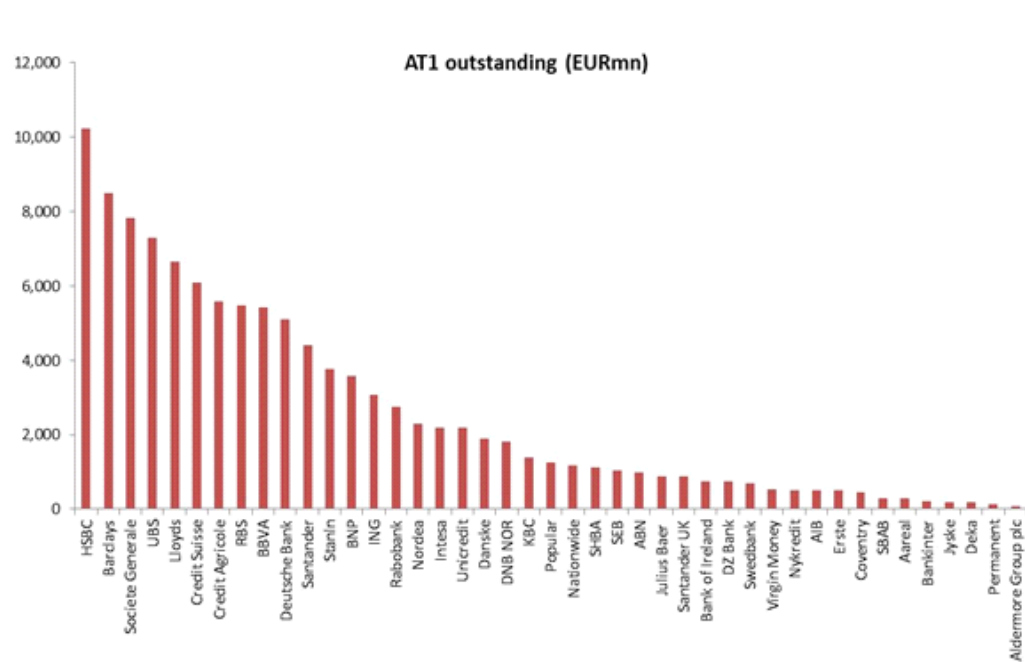


Figure 4.14: CoCo Issuance per Bank; Source: AT1 Handbook; Societe Generale (2016)

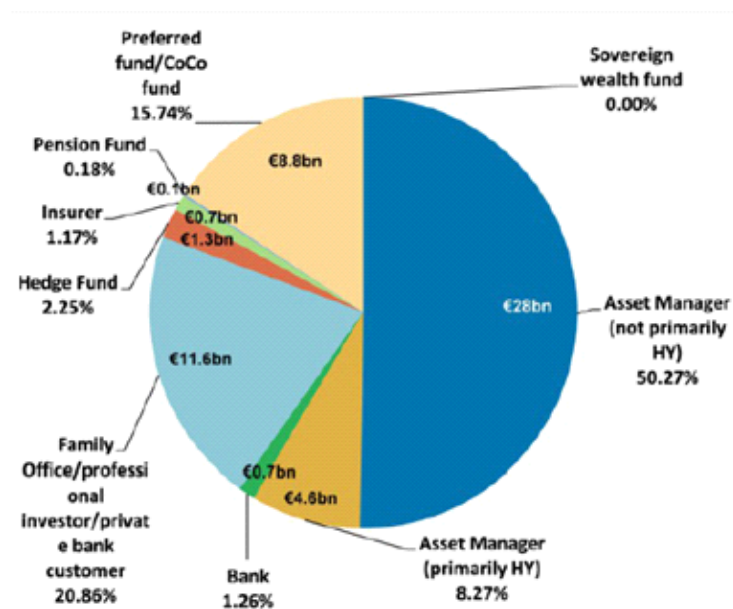


Figure 4.15: CoCo Investor Base; Source: Morgan Stanley 2016 AT1 Survey responses



Figure 4.16: CoCo Performance; Source: Bloomberg

Figure 4.17 also demonstrates that the CoCo index has generally outperformed other major indices such as the Financials Subordinate and Investment Grade Corporate Index.

Nowadays CoCos, especially AT1s, are priced either on yield or spread basis. We focus on the AT1 which represents the majority of the outstanding CoCo volume. The currency of the AT1 also determines whether the AT1 is priced to yield or to spread. For example, dollar investors that invest in dollar - denominated CoCos look at the yield whereas non-dollar investors (especially euro and sterling based investors) look at the spread. This has to do not only with the different investment approach (US investors care about the total return given the nature of their total return investment mandates) but also by stark difference between the levels of the risk free asset (the US treasury and the German bund) and the cross currency swap differential. US investors nowadays investing in euro CoCos with 7-8 years durations to call gain roughly 240bps of extra yield when swapping the bond from euros to dollars. This is the difference between the 10 year US bond minus the 10 year German bond plus the swap differential between both. The 10 year US bond, the 10 year

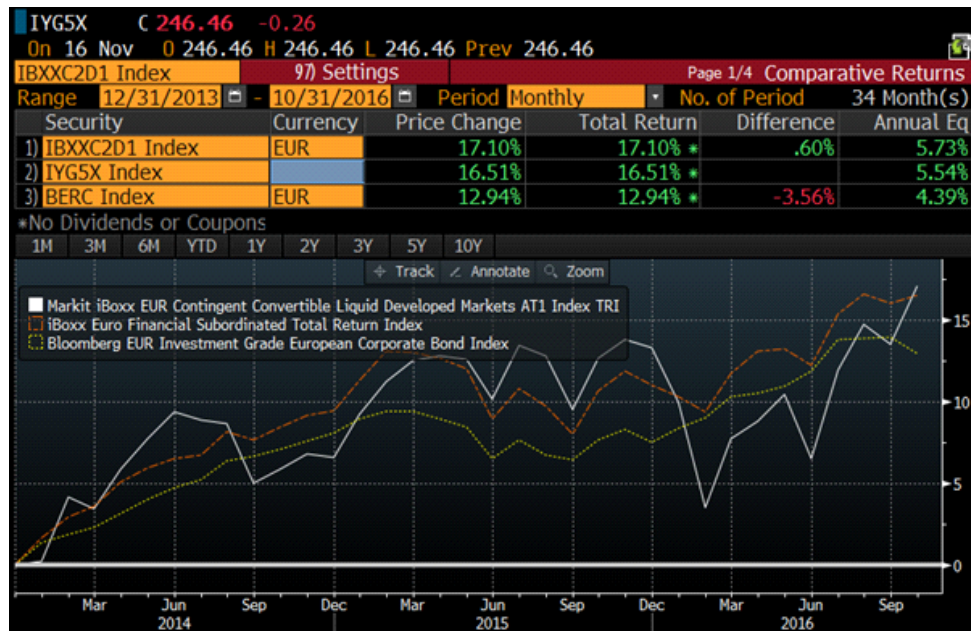


Figure 4.17: CoCo Relative Performance; Source: Bloomberg

German bond and the swap basis are shown in Figures 4.18, 4.19, and 4.20 respectively.

Another interesting feature of the AT1s is that given their perpetual nature, they come with an embedded call. Hence, investors price the bond to the call date (yield or spread to call - YTC) or the maturity (yield or spread to perpetuity - YTP). The decisions boil down to several factors. We list some of them:

- **Fundamentals:** The level of the bank's solvency by the call date. If the solvency is low, the regulator would probably hamper the call exercise given that the bank will be forced to pay a higher premium to the existing AT1 yield or coupon given the weak credit fundamentals of the bank. Then the AT1 would be priced on a YTP basis.
- **Economics:** the reset price after the call. AT1s come with a reset coupon after the call is not exercised. If the bank can leave the AT1 outstanding with a lower coupon (as the coupon steps down) than the hypothetical one it would have to pay if the bond is called, then the incentive to call is low. Then the AT1 bond would be priced on a YTP basis.

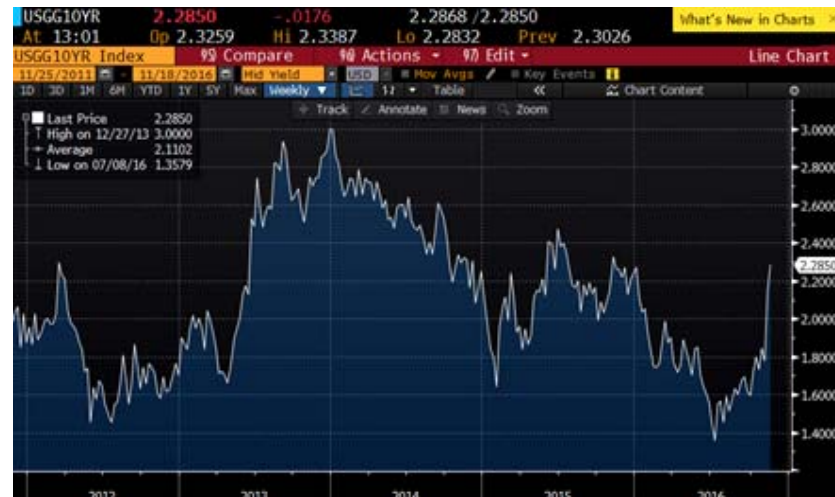


Figure 4.18: 10 Year US Bund; Source: Bloomberg



Figure 4.19: 10 Year German Bund; Source: Bloomberg



Figure 4.20: USD/EUR Swap; Source: Bloomberg

- Reputational: some banks are more bondholder friendly than others meaning that they tend to honour the commitment to call the bonds. This includes banks such as BNP, HSBC etc, in general strong credit quality names. Then, the AT1 bond would be priced on a YTC basis.
- Rates: AT1s, as callable bonds, exhibit negative convexity at certain yield-price combinations. Negative convexity means that as market yields decrease, also does duration. This is illustrated in Figure 4.21.

In this chart, we show that to the right of Y, the bond exhibit positive convexity. In other words, at yields higher than Y, the bank would not call its AT1 since it will be forced to reissue a new AT1 at a higher interest rate. The bank will be more interested in calling the bond when the prevailing interest rate is below the callable bond's coupon. Any yield below Y, the bond has negative convexity, since the bank will have more incentives to call the AT1. Therefore, with yields below Y, the AT1 price will increase less than a non – callable bond.

In Figure 4.22, we show some of the main feature of the 6.75 12/26/49 BBVA AT1 with a call date in 2020. YTC is 10.7% whereas the YTP is 7.8% (calculated on forward

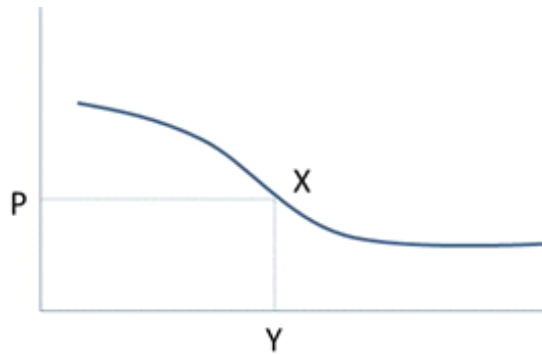


Figure 4.21: Negative Convexity; Source: author

rates) highlighting the acute price downside of this bond if the market assumes the bond will not be called. If this is the case, the bond fair value to perpetuity would be 63c (assuming the same spread to call but extending it to maturity).

The AT1 bond in detail

We now focus on the AT1 bond, by far the largest component of the CoCo market. There are three specific risks associated with AT1 bond investment that make it different from other subordinated debt: a risk to nominal capital, the risk of coupons being cancelled and extension risk. We briefly explain the main risks:

- Principal risk: Falling below the contractual CT1 trigger level or the Point of Non-Viability, thus suffering capital loss via write down or equity conversion.

Nowadays European banks have a comfortable capital buffers to trigger point as we can see below: See Figure 4.23.

- Coupon risk²⁰: AT1 coupons can be switched off under any circumstances – by management or the regulator. Once missed, the coupons are not recoverable. However,

²⁰EU banks that do not meet their combined buffer requirement (CBR) have become subject to a cap on how much they may pay in optional distributions. These include shareholder dividends and share buy-backs, AT1 coupons, as well as variable compensation (bonuses) and discretionary pension benefits (committed during the breach). This amount – the maximum distributable amount (MDA) – is calculated according to a pre-defined formula and is determined by reported profits not yet included in the bank's core tier 1. It

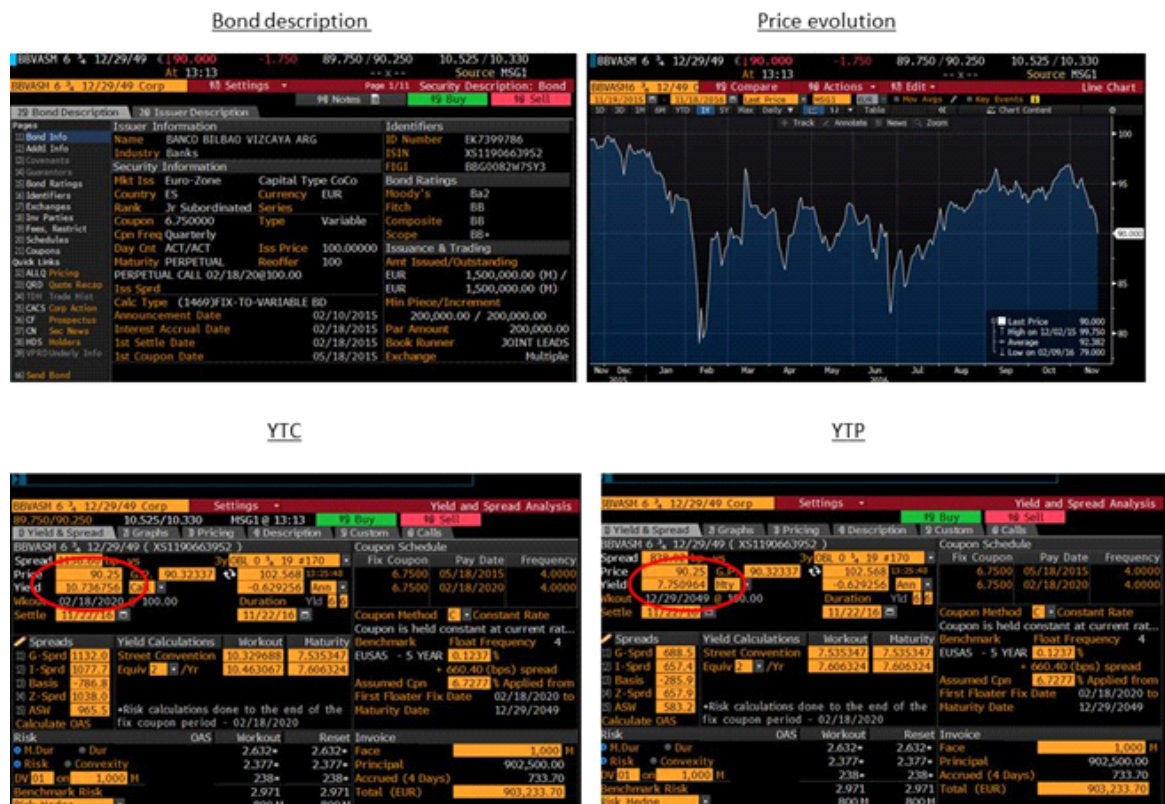


Figure 4.22: Pricing; Source: Bloomberg

coupons must be switched off if:

a) Falling below minimum regulatory (CT1 ratio) requirements, and thereby hitting the maximum distributable amount (MDA) hurdle rate. The MDA briefly sets the minimum level of Core Tier 1 before discretionary payments such as dividends, bonuses and AT1s coupons are suspended. See Figure 4.24 prove this.

European banks, except for a handful of banks, are boasting ample capital cushions to carry on with their discretionary payments for the foreseeable future. The exceptions have put in place comprehensive measures to bolster this buffer in order to reassure AT1 investors.

is scaled by a factor related to how far the CBR falls below its minimum requirement. The Commission has recently issued new law that prioritises the payment of the CoCo coupon relative to dividends and bonuses once the CT1 has breached the MDA, further supporting the AT1 market.

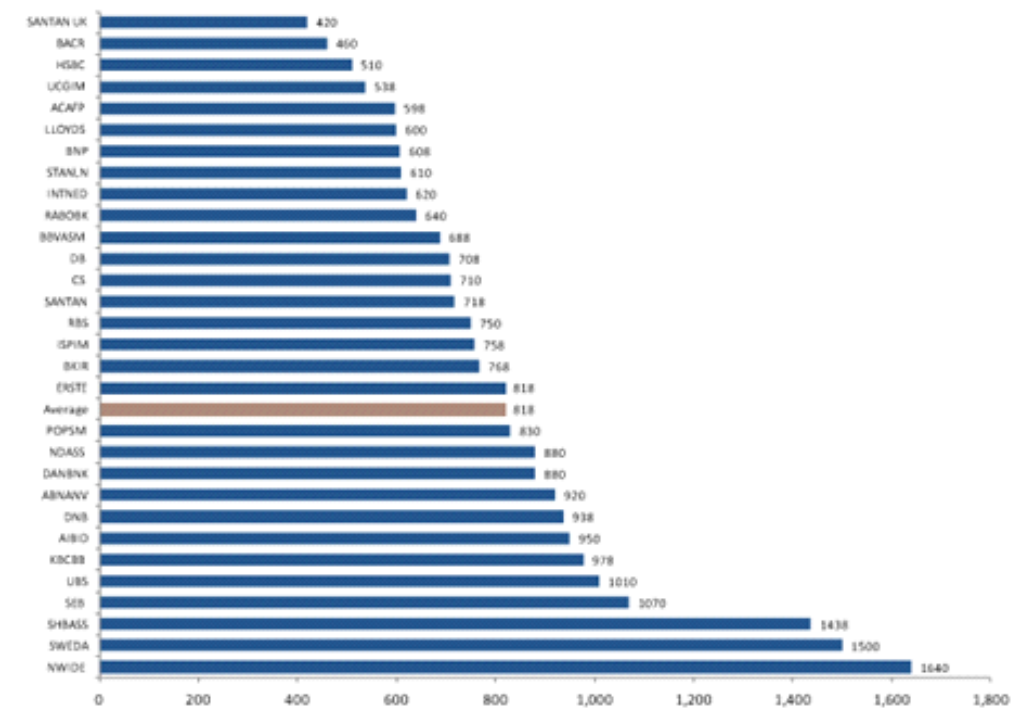


Figure 4.23: AT1 Trigger Buffer for European Bank; Source: AT1 Handbook; Societe Generale (2016)

b) Having insufficient available distributable items (ADI). For instance, the bank can suspend the AT1 coupon to save costs in order to grow the business or to offset a one-off loss even though the MDA is not breached.

As we can see in Figure 4.25, again, not a problem for most of the European banks.

c) The bank decides to exercise their right to skip the discretionary coupon (or the regulator requires it) for whatever reason.

3) Extension risk (or early redemption): Issuers may decide not to call the bond at the first call date (extension risk). Equally, they have the right redeem the bonds early (usually at par) on (extraordinary) loss of regulatory or a change to tax treatment.

AT1 market today is shown in Figure 4.26. More than half of the AT1s are in USD (there is a large investor base in North America and Asia). Moreover, UK is by far the largest AT1 market nowadays with 36% of the “pie”.

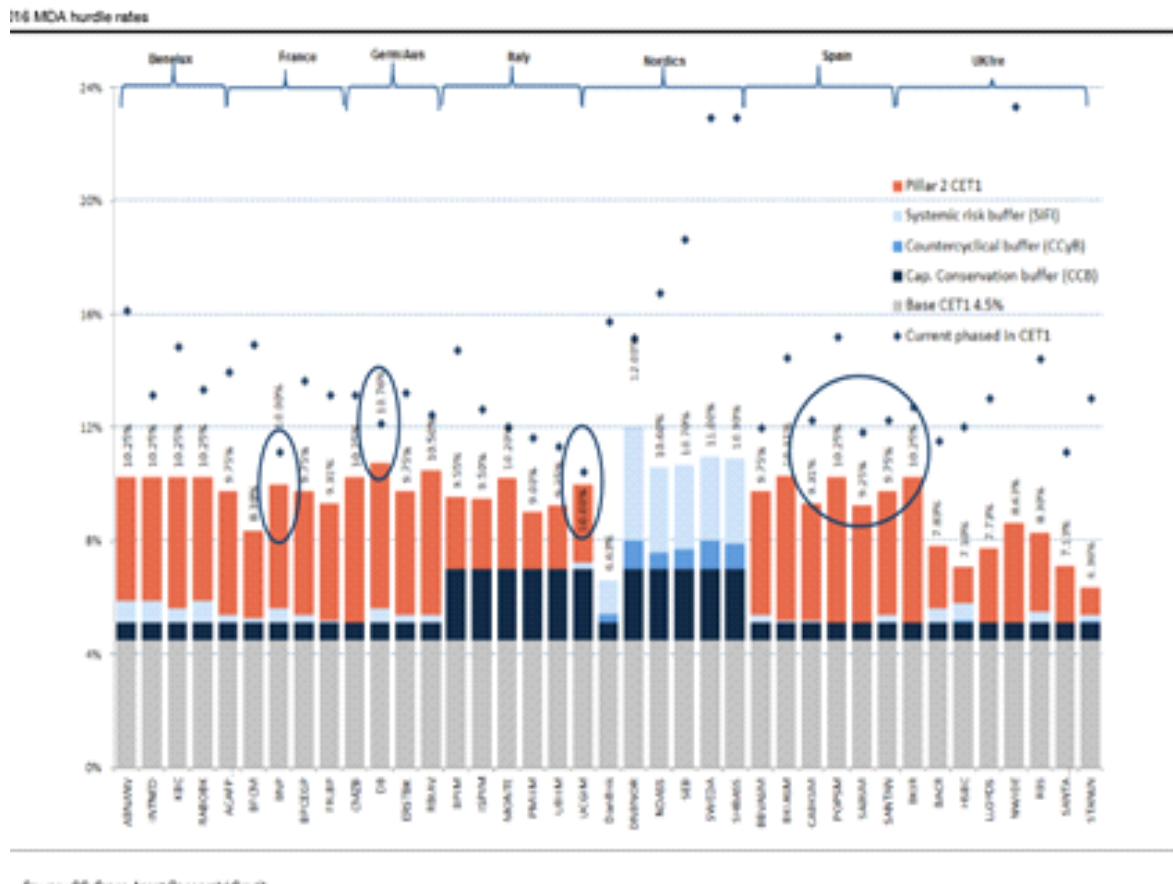


Figure 4.24: AT1 MDA Hurdle Rates; Source: AT1 Handbook; Societe Generale (2016)

Other interesting AT1 features are shown in the following figures. The market, according to SG (2016), will reach its peak in 2018 at €180bn as shown in Figure 4.27.

Figure 4.28 shows the AT1 annual supply peaked in 2014 so there is c. €60bn left for the bank to issue between 2017-19 and probably for the banks as shown below.

Figure 4.29 illustrates a small sample of AT1 bond returns versus comparable asset classes including equities. AT1 returns have actually fared better than that of the equity of the underlying CoCo issuer.

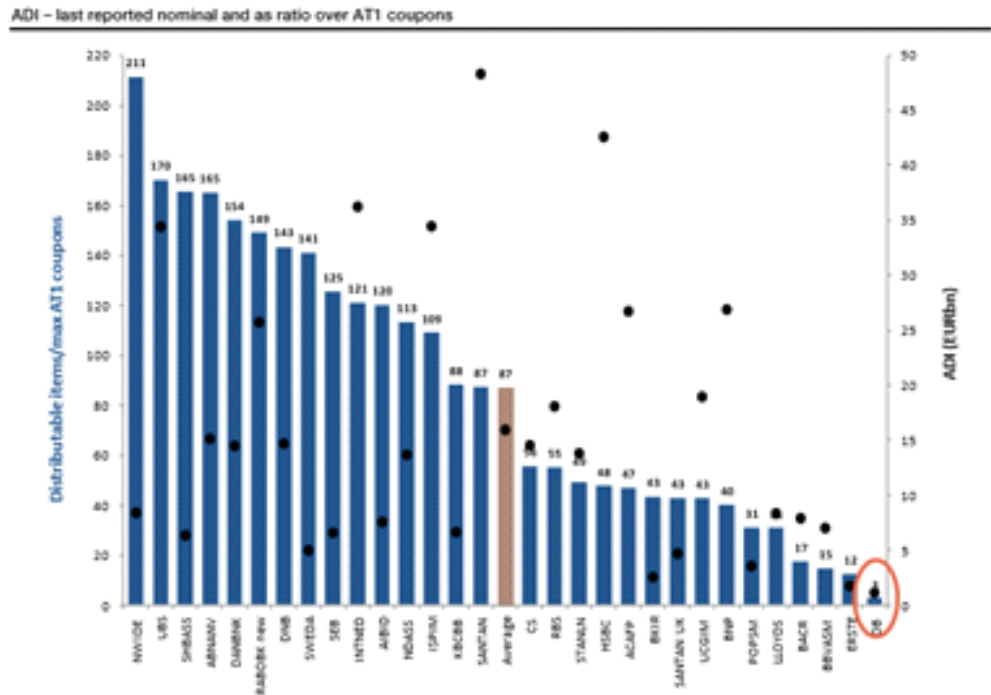


Figure 4.25: AT1 ADI; Source: AT1 Handbook; Societe Generale (2016)

4.4 Deviations from The Absolute Priority Rule (DAPR)

In any restructuring/liquidation event, equityholders should receive no value from the assets until all the creditors have been fully repaid²¹. Moreover, senior creditors should be paid first before the junior (subordinate) ones. This is the so-called Absolute Priority Rule (APR). The Black-Scholes-Merton analysis of liabilities from the option pricing theory is very useful to illustrate creditors' stake in the company as a call option holders on the bank's assets. When the bank defaults on its debt, creditors take over the bank. In other words, senior creditors have the right to claim both principal and interest on the bank's assets; once they are made full, they receive nothing beyond that. Senior creditors are in fact taking a covered call position on the assets. They are long the bank's assets and a short a European Call Option with a strike price equal to the outstanding senior debt.

²¹No Creditor Worse Off Rule also applies to observe seniority across creditors.

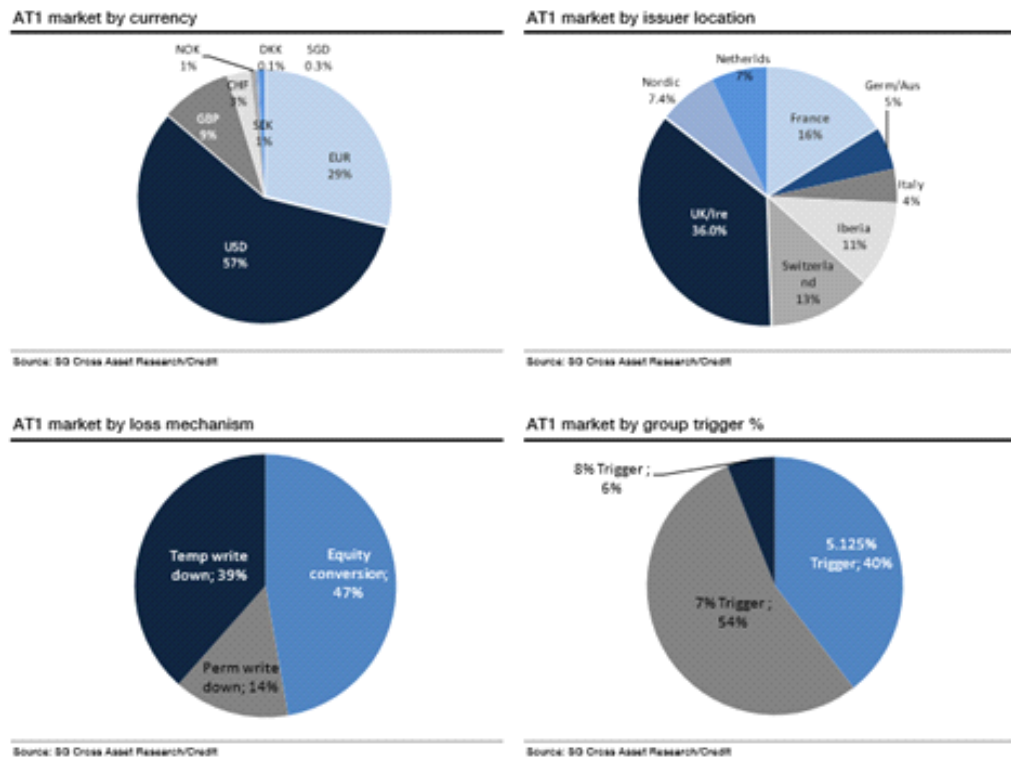


Figure 4.26: Global AT1 by Currency; Source: AT1 Handbook; Societe Generale (2016)

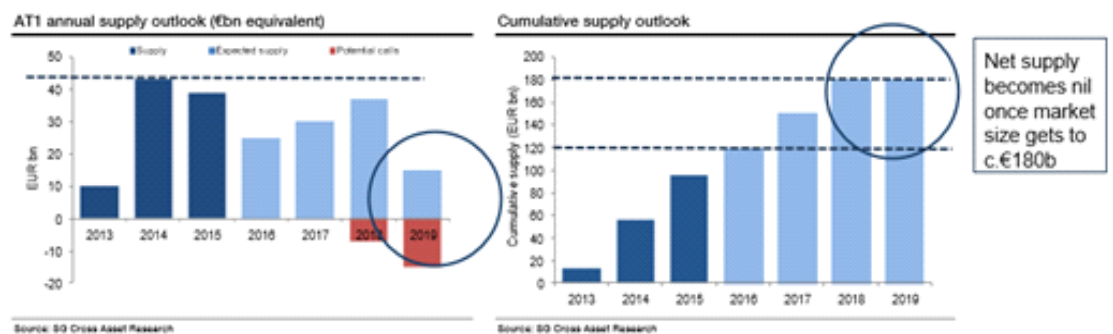


Figure 4.27: Global AT1 Issuance Peak; Source: AT1 Handbook; Societe Generale (2016)

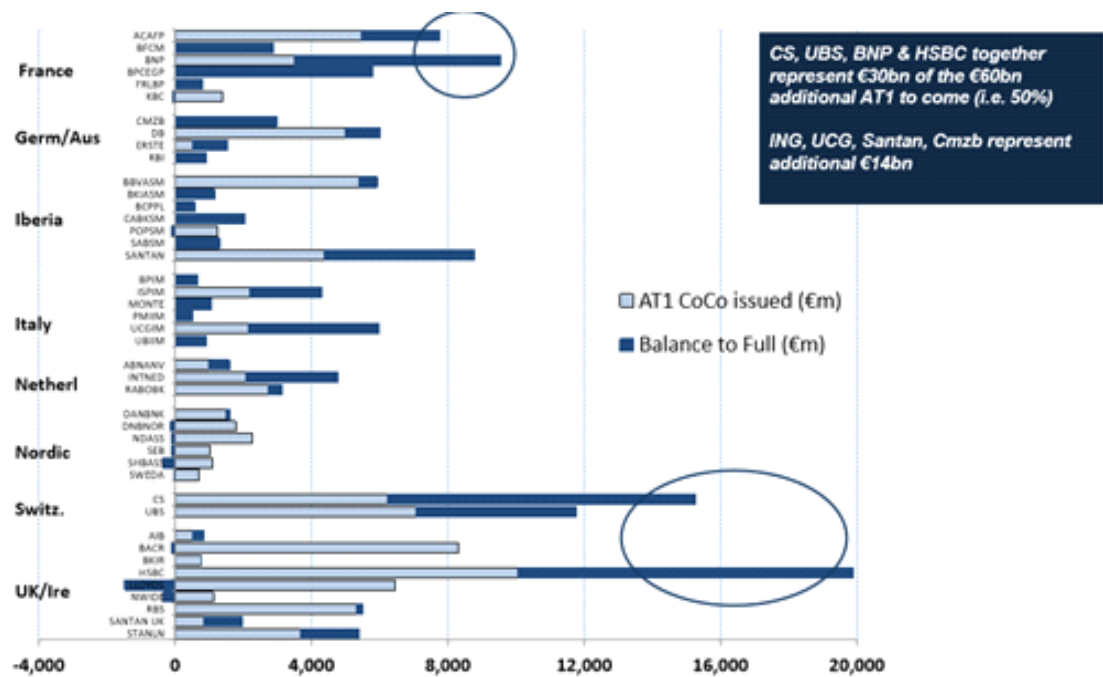


Figure 4.28: Banks; AT1 Issuance to Come; Source: AT1 Handbook; Societe Generale (2016)

	2013		2014		2015		2016 (ytd)	
Banks	AT1 (av)	Equity	AT1 (av)	Equity	AT1 (av)	Equity	AT1 (av)	Equity
Barclays	1%	9%	2%	-2%	11%	-7%	-3%	-28%
Credit Agricole			4%	-7%	8%	-3%	3%	-8%
Santander			3%	1%	3%	-34%	1%	-8%
BNP					5%	-5%	5%	3%
ING					4%	-6%	4%	-2%
UBS					7%	10%	3%	-20%
Insurance Sub	Hyb	Equity	Hyb	Equity	Hyb	Equity	Hyb	Equity
AXA (€5.5 PNC19)	2%	54%	13%	-1%	3%	36%	8%	-14%
Aviva (\$8.25% PNC17)	8%	25%	10%	12%	4%	8%	4%	-9%
Zurich (\$8.25% PNC18)	14%	13%	4%	27%	6%	-12%	2%	5%
Corp hybrids	Hyb	Equity	Hyb	Equity	Hyb	Equity	Hyb	Equity
Telefonica	10%	7%	13%	8%	0%	-11%	10%	-8%
Solvay	2%	2%	11%	0%	-6%	-5%	14%	8%
Enel	10%	23%	8%	21%	4%	9%	5%	3%

Figure 4.29: AT1 Returns vs Comparable Assets; Source: AT1 Handbook; Societe Generale (2016)

Subordinate creditors come after senior creditors. Their position can be represented by a bull-spread position on the assets. They are long a European Call Option with a strike price equal to the senior debt and short a European Call Option with a strike price equal to the overall amount of both senior and junior debts.

Finally, equityholders own the residual value of the bank once creditors are repaid. They are effectively long a European Call Option with a strike price equal to the overall amount of both senior and junior debt. These positions are depicted in Figures 4.30 and 4.31.

There is empirical evidence, largely in the US, that APR deviations are common in restructuring proceedings (Chapter 11) and informal workouts. These violations occur because they are privately optimal for all investors as strict observation of the APR can lead to perverse incentives for both equityholders and junior creditors and aggravate the embedded agency costs. In fact, the APR deviations are basically payoffs from creditors to equityholders to make wise investment decisions while the firm is in distress.

Bail-in should in principle observe the Priority Rule and the Pari Passu treatment

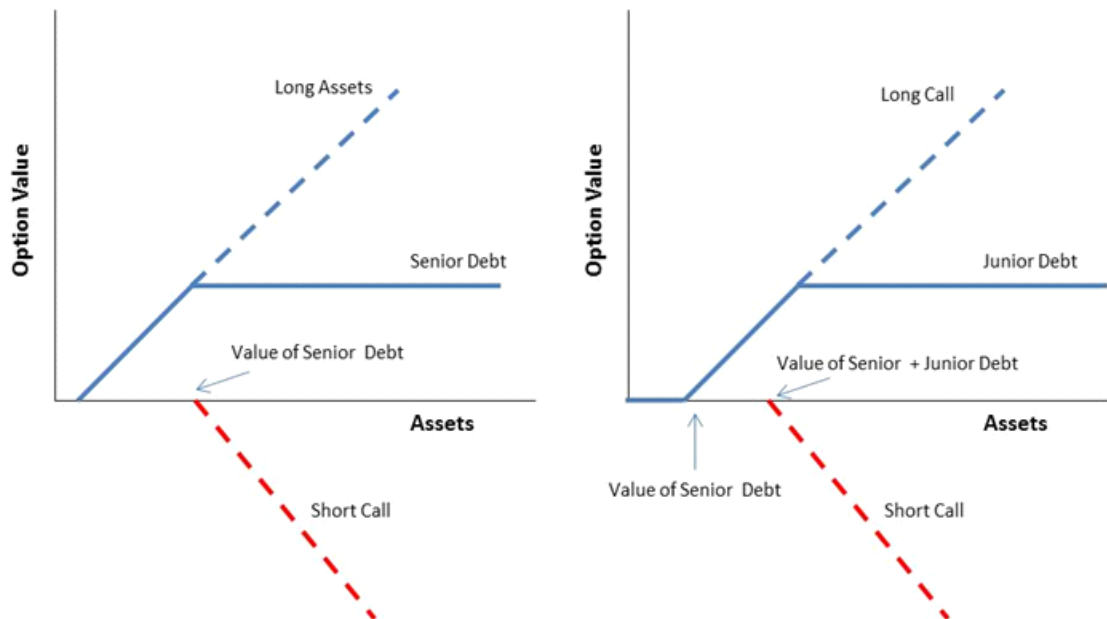


Figure 4.30: Senior and Junior Option; Source: author

of creditors when imposing losses to bondholders. Guiding Principles imply that:

- Equityholders and creditors should not be worse off than in liquidation under a normal solvency proceeding.
- Bail-in should be conducted in such a way that preserves the pari passu treatment of all creditors and the statutory rank which is envisaged under the insolvency law.

Though Bail-in underlines that supremacy of creditors over equityholders (in the sense that equityholders take the first loss as in any restructuring proceeding), it does not mention anywhere that bondholders should only take the second piece until the equity is fully wiped out. Moreover, since statutory/contractual Bail-in contemplates events where bondholders suffer losses before the equity is depleted highlights the breach of the Absolute Priority Rule that should govern the capital markets. This is the so-called Deviation from the Absolute Priority Rule (DAPR).

Consider the following example:

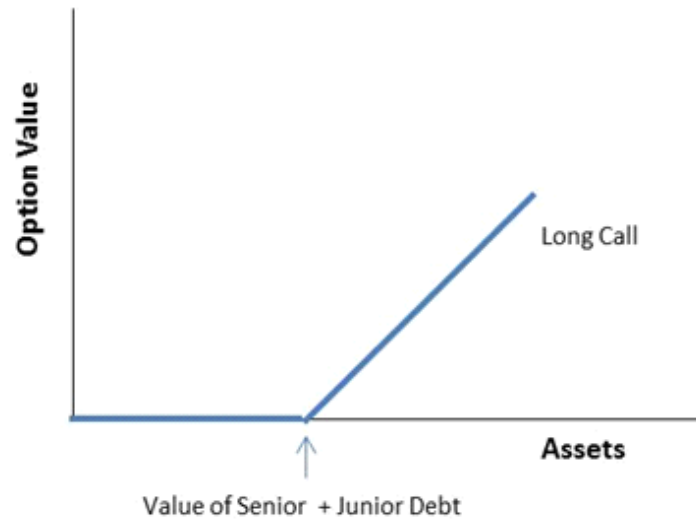


Figure 4.31: Shareholders Option; Source: author

Figure 4.32 shows a bank with 100bn assets funded through 10bn of equity, 2bn of subordinate debt with a 100% write-down clause and 28bn of Bail-in able debt. CT1 and T1 ratio are 10% and 12% respectively.

Assets (bn)		Liabilities (bn)	
Ex ante Assets	100	Deposits	30
		Short term senior	30
		Bail in able senior	28
		Tier 1	
		Subordinate	2
		Equity	10
		Ratios	
		Core tier 1	10%
		Tier 1	12%

Figure 4.32: Capital Structure

Now the bank incurs a one off loss of 10bn as in Figure 4.33 dragging CT1 below 7% which triggers the write-down mechanism of the subordinate bond. Furthermore, as the

subordinate bond is not large enough to tackle all losses, Bail-in on senior debt kicks²² in and helps absorbing losses.

Assets		Liabilities	
Ex ante Assets	100.0	Deposits	30.0
Loss	(10.0)	Short term senior	30.0
Ex Post Assets	90.0	Bail in able senior	21.0
		Tier 1	
		Subordinate	0
		Equity	9
Ratios			
		Core Tier 1	10%
		Tier 1	10%

Figure 4.33: Post Losses Capital Structure

Pre loss CT1 is 10% before the one-off loss. Equityholders take the first 3.7bn up to the 7% trigger where subordinate holders take the second loss and are wiped out. As there are still 4.3bn of losses, Bail-in able senior take the third loss. CT1 is still 7% so some Bail-in able senior is converted into equity to restore CT1 to 10%.. In figure 4.21, one can see the subordinate and senior bondholders take the brunt of losses (100% and 25% respectively) while equityholders only take a 37% loss with a potential full recovery²³ should the losses happen to be just an exceptional event or in due course, the bank manages to restore profitability once the loss making exceptional is gone. This is show in both Figure 4.34 and 4.35

²²From 2016 onwards, Senior Bail-in will be available (contractually, statutorily or structurally) as a going concern absorbing tool.

²³This is out of the scope of this thesis but one can quickly infer the harsh treatment on bondholders that lose most of their investment whereas equityholders just suffer some initial losses (and further dilution upon senior bond conversion into equity) but could overcome these losses in the future. Financial shares always trade on a normalized ROE basis (Price to book vs ROE) so if the underlying business of the bank is unaffected after the one-off loss, shares could trade back up to the pre one-off losses level quickly and shareholders recover their initial loss whereas subordinate bondholders have seen their investment wiped out.

Assets		Liabilities	
Ex ante Assets	100.0	Deposits	30.0
Loss	(10.0)	Short term senior	30.0
Ex Post Assets	90.0	Bail in able senior	21.0
		Tier 1	
		Subordinate	0
		Equity	9
		Ratios	
		Core Tier 1	10%
		Tier 1	10%

Figure 4.34: Loss and Trigger

	Loss
Equity	37.0%
Subordinate	100.0%
Bail in able senior	25.0%
Written Down	15.0%
Converted into equity	10.0%

Figure 4.35: Recovery Value

4.5 Changing the Mathematics for Bondholders

Under a Bail-in regime, “maths” are going to change for bondholders. Instead of taking the Probability of Default (PD)²⁴ as an input, it will be “probability of Bail-in” (PB-in). Likewise, the LGD (Loss Given Default) will become “loss given-Bail-in” (LGB-in). The interplay between these two elements pre and post B3 to derive the cost of bond funding for banks will change:

- LGD vs LGB in: one could argue that LGB-in could be lower for bondholders than

²⁴The bond spread is a function of the probability of default (PD) and the loss given default (LGD) which is the expected loss (EL).

the LGD. By lowering the probability of sudden liquidity stops for failing banks²⁵, bondholders' recovery rates could increase. Moreover, a strong resolution framework that avoids contagion risks across banks, could render PB-in lower than PD. However, the fact that most of subordinated and senior bondholders have been bailed out without being impaired has kept the historical LGD at low levels. Therefore, as regulators seek to minimize the risk of Bail-out by incorporating Bail-in into the unsecured bonds, LGB-in will probably be higher than LGD as bondholders will suffer losses on a going concern basis.²⁶

- PD-PB-in: one could argue here that as Bail-in tools will only be triggered once the bank is close to failure, the difference between both should not be too marked. However, B3 Bail-in tools contemplate the activation of Bail-in via contractual (bond indenture) or statutory (regulator powers) means. Therefore, unsecured bondholders could well be written down/off or converted into equity before any new equity injection is undertaken, implying that, in practice, PB-in is likely to be higher than PD. Moreover, writing bondholders down/off or converting them into equity before the entire equity layer is wiped out, will mean that Bail-in bondholders do not sit in the asset class of their choice anymore. In a write-down featured bond, creditors take losses either permanently or temporarily before equityholders stake²⁷ is consumed. In an Equity Conversion bond (CoCo), bondholders could be forced to sell the new equity once received, putting pressure on their ultimate recovery value. In either situation, PB-in is higher than the PD²⁸.

4.6 The Net Stable Funding Ratio

The Net Stable Funding Ratio (NSFR) is one of the new liquidity ratios proposed by Basel III that aims at promoting a more stable funding base for banks in the long-term

²⁵And hence avoiding fire sales of assets.

²⁶Whereas bondholders of failing banks used to take losses on a gone concern basis (based on recovery values in a restructuring proceeding) due to the absence of bail-in clauses within the bond indentures.

²⁷Deviation from the Absolute Priority Rule.

²⁸Making the cost of funding higher.

by improving the duration matching between assets and liabilities. During the financial crisis, many failing banks' balance sheet were characterized by long-term assets (loans, mortgages etc.) funded by short-term liabilities (repo, short-term debt etc.). Hence the liquidity shortage that came about through the first months of the crisis prevented these banks from rolling over their debt compromising the integrity of the world financial system.

The introduction of Bail-in and the potential increase in the cost of debt via CoCo and Bail-in able debt could potentially encourage banks to issue secured debt: deposits, short-term or covered bonds (which are usually short-term debt) which are excluded from the Bail-in framework. This situation could actually worsen the maturity mismatch that in general characterizes the banking industry. To mitigate that risk, the regulator introduces the net stable funding ratio (NSFR) a new ALM (Asset Liability Management) ratio to tally the duration of both asset and liabilities to avoid the over reliance on the short-term debt market

The choice between short and long-term liabilities for banks is not an obvious one. Short-term liabilities usually command lower cost of funding for banks. It is moreover a powerful discipline tool for investors to capture the increasing risk appetite of the bank and to reflect it into the new debt²⁹ as the bank secures new funding. However, short-term debt is prone to liquidity “squeezes” should the bank fail to roll over the debt that leads to an increase in the default probability of the bank. Long-term debt promotes financial stability and maturity matching though it is more costly for banks³⁰. There is an additional problem which has been overlooked so far on the face of the new NSFR ratio. Long-term debt could give rise to debt overhang which could undermine the effectiveness of some of new Basel III rules (higher solvency and leverage ratios³¹). The Appendix (Chapter 9) reviews this topic

²⁹Whereas long term debt (as opposed to short term debt) does not have to be refinanced/reimbursed and thus only the yield (and not the coupon) of the security (bond or loan) captures the increasing risk premium.

³⁰Investors tend to require a premium to compensate for lending long term as the default probability is higher. Banks need to manage the duration and interest rate risk (through hedging for example) pushing up the overall cost of funding.

³¹Strictly speaking, regulators and governments cannot force banks to lend (even after a Bail in) provided that they are still private entities with enough capital and liquidity. Even if a CoCo triggers at 7% to restore Core Tier 1 at 10%, the bank can still suffer from debt overhang as it cannot be legally forced to lend to the real economy (as it happened during the sovereign crisis). This can prompt banks to forego positive NPV projects.

	MREL	TLAC	Consistent?
Rationale	■ To ensure minimum bail-in capacity in resolution	■ To ensure minimum bail-in capacity in resolution	✓✓✓
Applicability	■ European banks only	■ G-SIBs globally	✓✓
Determination	■ Determined by resolution authority on institution-by-institution basis	■ FSB TLAC term sheet sets minimum but scope for home authority to determine firm-specific TLAC requirement	✓✓
Eligibility of instruments	<ul style="list-style-type: none"> ■ Own funds and eligible liabilities ■ Issued and fully paid up ■ Not owed to / secured by / guaranteed by the institution itself ■ Not funded by the institution itself ■ Remaining maturity of at least 1 year for eligible liabilities ■ Cannot arise from a derivative or from a deposit benefitting from preference in insolvency hierarchy 	<ul style="list-style-type: none"> ■ Paid-in ■ Unsecured ■ Not subject to set off or netting rights ■ Perpetual or have a minimum remaining contractual maturity of at least 1 year ■ Not redeemable by the holder ■ Not funded by the resolution entity ■ <u>Must be contractually, statutorily or structurally subordinated to excluded liabilities (such as insured deposits, liabilities arising from derivatives or debt instruments with derivatives linked)</u> 	×
Calculation	$\frac{(\text{Own Funds} + \text{Eligible Liabilities})}{(\text{Total Liabilities (Ex. Derivatives)} + \text{Own Funds})}$	$\frac{\text{TLAC Eligible Instruments}}{\text{Risk Weighted Assets}}$	×
Requirement	<ul style="list-style-type: none"> ■ Set on an institution-by-institution basis but likely to be broadly in excess of 8% ■ Function of sufficient capital to absorb material losses and recapitalise institution to desired level 	<ul style="list-style-type: none"> ■ From 01-Jan-2019: Initial requirement of 16% of RWAs and 6% leverage ratio ■ From 01-Jan-2022: 18% of RWAs and 6.75% leverage ratio 	×
Timeframe	■ Binding from 1-Jan-2016 although flexibility to set requirement at a lower level initially	■ From 01-Jan-2019	×

Figure 4.36: MREL vs TLAC; Source: Goldman Sachs, BRRD and European Central Banks

more extensively.

4.7 An introduction to TLAC and MREL

To avert a new financial crisis and facilitate the transition from Bail-out to Bail-in, the regulator has come up with rules that forces the bank to hold enough loss absorbing instruments. TLAC (Total Loss Absorbing Capacity) and MREL (Minimum Regulatory Eligible Liabilities) ratios determine the minimum amount of equity and unsecured debt (both CoCos and plain vanilla debt) that each bank should hold to be able to absorb losses and avoid any resolution or wind up event. TLAC is only compulsory for SiFis (Systematically Important Financial Institutions) whereas MREL is mandatory for all banks. In figure 4.36 a detailed description of each ratio is outlined³².

³²The idea is that all banks should have enough Bail-in able liabilities and equity, including senior unsecured debt, before the bank resorts to public money or faces resolution..

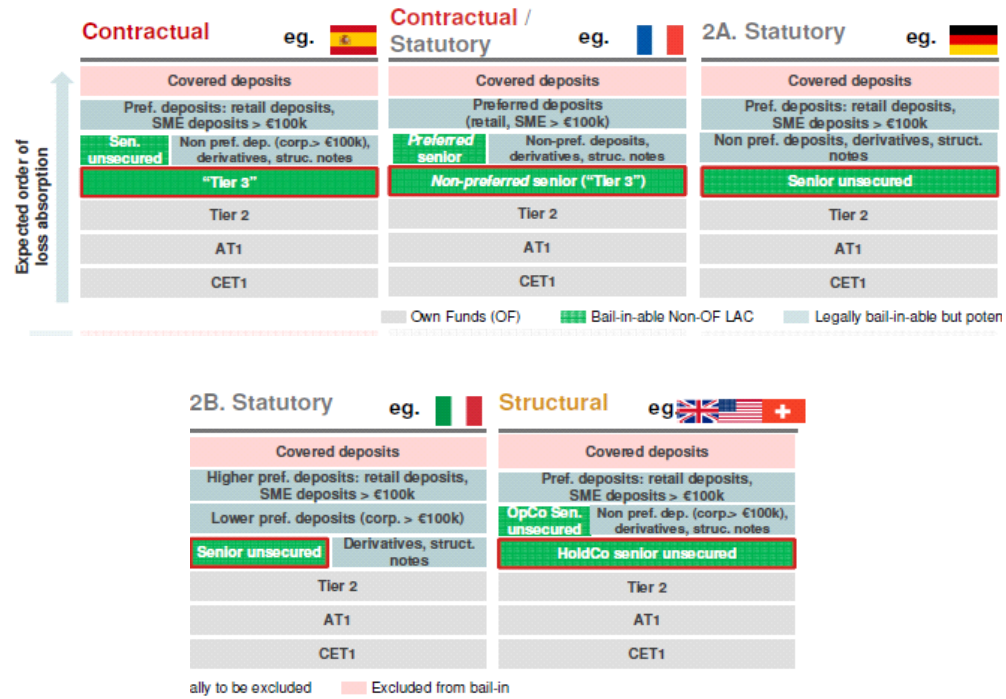


Figure 4.37: TLAC Approach to Senior Unsecured Debt; Source: Nomura – Regulatory Capital Update

As explained in the following chapters, senior unsecured debt (that ranks *pari passu* with deposits which are secured debt and hence falls out of the Bail-in rules) has been subordinated relative to deposits to enable the bank to swiftly comply with these ratios and curb the necessity of issuing subordinate debt to meet these capital requirements. There are several approaches to achieve subordination for TLAC / MREL as illustrated in Figure 4.37.

Following Nomura (Figure 4.38), thus far, there are several approaches for senior subordination:

- By virtue of a specific contractual provision inserted in the bond's documentation with the effect of creating a new layer of subordinated debt ranking below senior and above T2.
- By virtue of mandatory provisions of law, ranking of claims in insolvency amended,

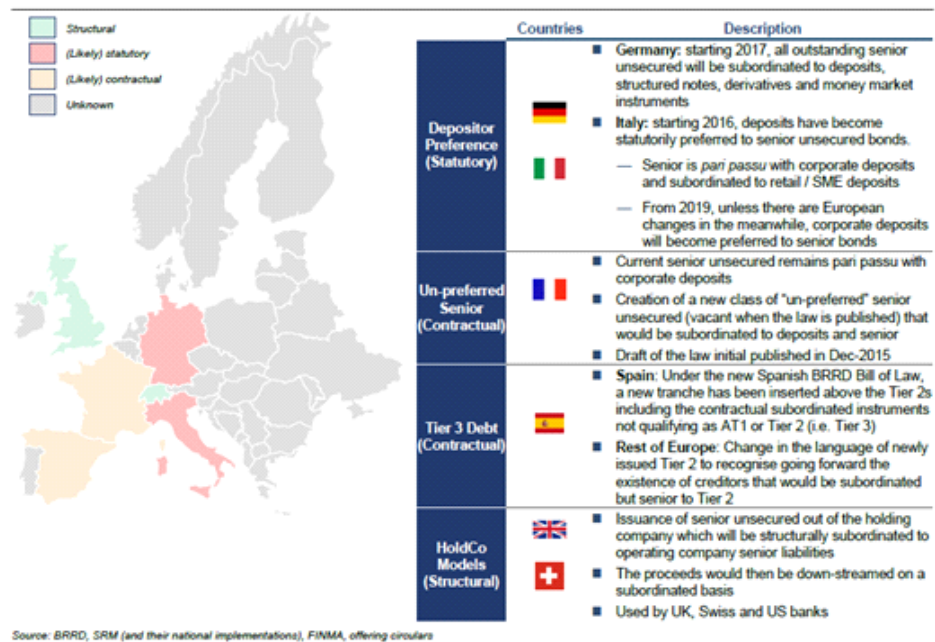


Figure 4.38: TLAC in Europe; Source: Nomura, BRRD, SRM and FINMA

such that a new layer of senior liabilities rank below existing senior debt and liabilities likely to be excluded from bail-in with the effect of creating of a new layer of senior debt ranking below other senior debt and above T2.

- By virtue of mandatory provisions of law, ranking of claims in insolvency amended, such that certain senior liabilities rank below liabilities likely to be excluded from bail-in with the effect of making senior unsecured to rank below other types of senior debt.
- By virtue of mandatory provisions of law, ranking of claims in insolvency amended, such that certain excluded liabilities rank above senior unsecured targeted for bail-in with the effect of making corporate deposits “lifted” to rank above senior unsecured.
- Or subordination achieved by issuing debt out of a “clean” non-operating HoldCo (NOHC), which sits above OpCo in the group corporate structure with the effect of making NOHC senior debt structurally subordinated to OpCo excluded Liabilities.

Figure 4.39 illustrates what TLAC/MREL means for the banks in respect of further capital requirements. If one adds Pillar 1 and 2, Combined Buffer, Management Buffer and the TLAC requirements, banks will be running in excess of 20% of RWA in loss absorbing instruments. This, as discussed in Chapter 7, will undoubtedly have a dramatic impact on the overall cost of capital of the bank as unsecured creditors incorporate the risk premium of the ownership of going concern loss absorbing instruments.

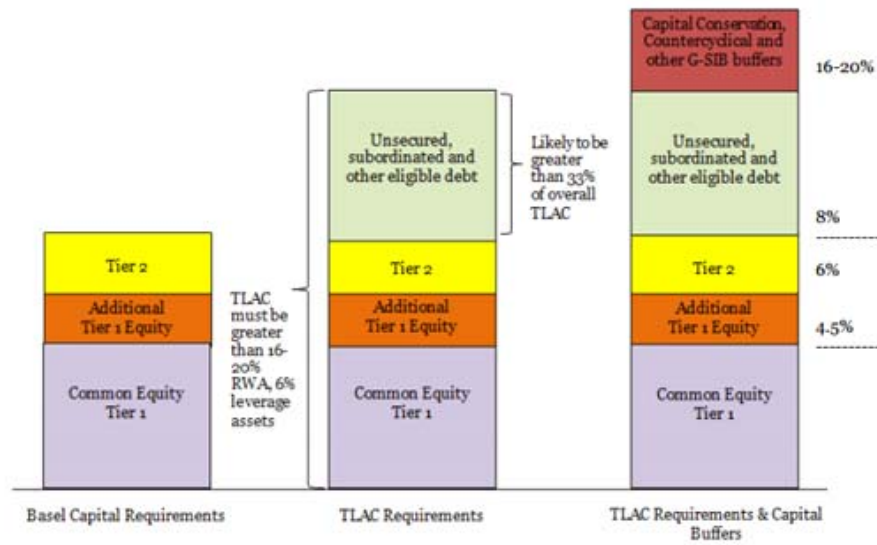


Figure 4.39: TLAC Impact on Capital Requirements; Source: Overview of Recent Regulatory Developments on TLAC/MREL and MDA Goldman Sachs International April 2016

4.8 Concluding Remarks

In this chapter we have reviewed the existing banks' regulatory capital regime as well as focused extensively on the CoCo instrument and Bail-in. As one can observe, it has become a very popular product among investors and the appetite for it has not waned despite its volatility. However, it is a very intricate product that has given rise to a new terminology that investors are now grappling with. Familiarising with these concepts is paramount to navigate through the next chapters of the thesis that go about the analytical framework

that underpins our argument that Bail-in and CoCos exacerbate the perverse incentives of shareholders and give rise to increasing agency costs for the banks.

4.9 Appendix

4.9.1 Regulatory framework to implement CoCos and Bail in Able debt

In the table below we outline the three main regulatory pieces of legislation that has enabled the regulator to implement “Bail-in” (and hence CoCos) across the EU banking system:

Basel III
<p>“Basel III” is a comprehensive set of reform measures in banking prudential regulation developed by the Basel Committee on Banking Supervision, to strengthen the regulation, supervision and risk management of the banking sector. These measures aim to:</p> <ul style="list-style-type: none"> - improve the banking sector’s ability to absorb shocks arising from financial and economic stress, whatever the source - improve risk management and governance - strengthen banks’ transparency and disclosures.
CRDIV
<p>In 2013, the European Union adopted a legislative package to strengthen the regulation of the banking sector and to implement the Basel III agreement in the EU legal framework. The new package replaces the current Capital Requirements Directives (2006/48 and 2006/49) with a Directive and a Regulation and is a major step towards creating a sounder and safer financial system.</p> <p>The Regulation contains the detailed prudential requirements for credit institutions and investment firms while the new Directive covers areas of the current Capital Requirements Directive where EU provisions need to be transposed by Member States in a way suitable to their respective environment.</p>
BRRD (Eu Bank Recovery and Resolution (BRRD))
<p>This draft Directive is designed to provide ‘adequate tools at European Union level to effectively deal with unsound or failing credit institutions’. It aims to make sure a bank or an institution can be resolved speedily and with minimal risk to financial stability. The Directive preserves systemically important functions when a bank fails so that, on failure, shareholders and creditors, rather than taxpayers, bear the losses</p>

Figure 4.40: Regulatory Framework for CoCos and Bail-in; Source: EBA (European Banking Authority)

Chapter 5

Agency Costs of Bail-in and Optimal Volatility

The new financial regulation, namely Basel III, will have a strong impact not only on the nature of the banking business,¹ especially on the capital structure of the banks. Among the new Basel III features,² the new style of subordinate debt stands out the most: the CoCo (Contingent Convertible) bonds. This is an intricate product which is becoming in vogue in a low yielding environment, as investors rush into high yield instruments, and banks take advantage of it by issuing a “cheap” (relative to the cost of equity of the banks) equity-like instruments that helps bolstering the capital and leverage ratios.³ However, the lack of standardization⁴ and its complex nature means that its impact on banks’ behaviour is not yet well understood.⁵

In this chapter, we investigate the main shortcomings of the new financial regulation overall, and the CoCos in particular, which is the overlook of the impact on the agency costs. Here two elements of agency costs are investigated. The first is the *wealth-transfer*

¹Banks retracting from high ROE but high RWA businesses, such as investment banking, structured credit, etc.

²E.g. Leverage Ratio, Net Stable Funding Ratio, etc.

³See for example, “CoCo Bond Feeding Frenzy Sends Yields Tumbling”, *The Financial Times*, March 26, 2014.

⁴Such as equity conversion ratio, permanent/temporary writedowns/offers, high/low trigger and the embedded equity option (for equity conversion CoCos).

⁵See for example, “Regulators must act on coco bond risks”, *The Financial Times*, May 7, 2014.

problem, where the equityholders have an incentive to take on riskier projects because of the long option position held by them, and “sold” by the guarantors - the government in the Government Bail-out case and the bondholders in the Bail-in cases. Higher volatility of the projects’ values means higher option value, leading to wealth being transferred from the guarantors to the equityholders.⁶ The second is the *value destruction problem*, where in a falling solvency scenario the equityholders are tempted to “gamble-for-ressurrection”, in other words, sacrificing value for higher volatility. We investigate these as the unintended consequences of the deviation from absolute priority rules (DAPR).⁷ Under the absolute priority rule (APR), bondholders should not bear losses until equityholders have been wiped out. Since the banks are systemic entities, the regulator has so far largely rescued troubled banks (“Bail-out”) to minimize market disruptions and deposit runs, which have historically exacerbated the intrinsic moral hazard of the banking industry. To tackle this, the new financial regulation advocates for the bondholders to assume losses (“Bail-in”) on a going concern basis (hence “deviation” from APR). We agree that Bail-in should replace Bail-out as investors and not taxpayers should bear the losses of their bad investments. From the equityholders’ standpoint there is not much difference between the two: when the regulator deems the bank’s point of non-viability (PONV) in a Bail-out (the point at which a Bail-out is triggered) at the level where the CoCo triggers are set (7%) in a Bail-in, the equityholders take the first loss down to 7% Core Tier 1 (CT1), for either taxpayers (Bail-out) or bondholders (Bail-in) to subsequently take any further losses to replenish the CT1 back to the pre-crisis level. Our view is that in the Bail-out there is an embedded moral hazard problem, while in the Bail-in there are agency costs that arises from the violation of the priority rule. The new Bail-in set-up simply replaces the former with the latter. This is demonstrated by our investigation of the payoffs of different Bail-out/in scenarios

We extend our analysis of these agency costs by developing an optimal volatility

⁶Basically, the buyer of an option is then able to determine the volatility of the underlying asset. If this was possible in a financial market, then it would be an illegal market manipulation.

⁷The DAPR has been magnified more recently by the introduction of the Maximum Distributable Amount (MDA) that kicks in when the CT1 falls below the Combined Buffer (comprised by the Conservation, Countercyclical and Systemic Buffer) which forces the bank to suspend coupons and dividends through a ratchet structure. The new Additional Tier 1 (AT1) CoCos are coming with no dividend pusher / stopper, meaning that banks can suspend CoCos coupons whilst still paying out dividends in the event of the CT1 falling below the combined buffer.

model of firms using equityholders' indifference curves. More specifically this establishes that the agency problem can be illustrated as a sale of an option structure from the bondholders to the equityholders, where the buyer of the option, the equityholders, have the right to choose its volatility. The question that we ask is then what the chosen level of volatility is by the banks and how it is affected by the new Bail-in structures. The vast theory of firm literature does not tell us how a firm selects its optimal level of risk. Under the Absolute Priority Rule (APR) the equityholders have a payoff structure that is a call option (their loss is limited to their current position, while the potential income upside is unbounded). The positive vega position of an option means that the value of the equityholders' position increases as the volatility increases. There is, however, no solution to the equityholders' optimal risk selection problem. In the second half of this chapter, we develop a model of firm where a firm's activities are a portfolio of correlated projects, with uncertain future values and independent project-specific risks. Analogous to Markowitz's portfolio theory, there is a concave risk-future value "portfolio frontier" (here termed "project plans"). The crucial point is that the future values are discounted at the required rate of return for the associated risk, leading to better diversified project plans to be discounted at a lower rate. This results in a trade-off between the present value of the firm, V_0 , and its associated risk, σ . The first-best optimal choice of risk maximizes the value of the firm. The equityholders' choice of risk is determined by their indifference curves that is a loci of the pairs (V_0, σ) that yields the same present value of their position. They choose the highest indifference curve that is feasible with the firm's possible project plan, given by the one that is tangent to the project plans curve. Different Bail-out / Bail-in structures have different set of indifference curves, with steeper indifference curves yielding higher optimal risk choices. Our analysis demonstrates that higher leverage means higher risk choice, and for reasonable levels of leverage, the equityholders choose risks in the ascending order for the cases of expropriation (where the equityholders are completely wiped out as the government takes over the firm), government Bail-out, and bondholder Bail-ins with equity-conversion CoCo bond and write-off CoCo bond, respectively. The choice of higher volatility means a transfer of wealth from bondholders to equityholders (from the seller of the option to the buyer), while the sub-optimal solution (i.e. non-value maximizing) means value destruction.

Given this outcome, the next question asked is whether there is a way of alleviating the equityholders' incentive for high risk-taking. Using the above model, we are able to show that by imposing higher required rate of return for higher risk-taking, the equityholders will rationally reduce the risk-level chosen. In policy terms this is analogous to Pigouvian tax. The agency costs are the negative externality of equityholders' actions on the remaining stakeholders of the bank. By implementing higher costs on their action, the regulators can force the equityholders to select less risky choice. Alternatively, leaving it to the bondholders, this is akin to them demanding higher cost of debt, compensating them for their cost of closely monitoring the credit quality of the firm. The monitoring efforts that the bondholders are forced to bear due to their exposure to going concern losses translate into a cost that will be borne by the equityholders in the end via a higher cost of capital. This fact has been overlooked by the regulator and the market so far. The implementation of this idea will be explained in the next chapter.

This chapter underscores the implicit agency costs of Bail-in in general and CoCos in particular. Relying on revolutionary option pricing based models, we analytically prove the aggravation of the wealth transfer and value destruction of the new banks' capital regime as the solvency deteriorates in a more detailed and accurate fashion.

The chapter is organized as follows. In Section 5.1, we describe comprehensively the four structures under comparison: no Bail-Out/Bail-in, Government Bail-out, Bail-in with CoCo bonds and with Writedown bonds. We demonstrate that in the Bail-in cases, the DAPR inherent in the structures can be valued as "condor-like" structures⁸ held by the equityholders. This allows us to derive expressions for the prices of the Bail-in bonds. In Section 5.2, we dwell on the wealth-transfer element of the agency cost demonstrated by the rising vega of the equityholders' positions. We also identify the regulators' problem of a trade-off between banks' safety and the wealth-transfer agency cost. In Chapter 5.3, we demonstrate that Bail-in increases the value destruction incentive of the equityholders, represented by the falling delta-vega ratio of the equityholders' positions. In Chapter 5.4, we compare the CoCo Bail-in structure with the traditional DES. Chapter 5.5 develops the

⁸A *condor* is created by a combination of either a bull call spread with a bear call spread, or a bull put spread with a bear put spread.

optimal volatility model using indifference curves, to demonstrate that Bail-out / Bail-in structures result in higher risk-taking by the equityholders and higher value destruction for the firm. This is demonstrated to be alleviated if higher required rate of return can be applied to higher risk-taking behaviour. In doing so, we emphasize the role that bondholders' monitoring costs will play once Bail-in structures are introduced. Finally in Chapter 5.6, we give concluding remarks for this section.

5.1 Comparison of Structure

We first investigate in detail the payoff structures of the following bail-out/in schemes:

1. No bail-out/bail-in
2. Government bail-out
3. Equity-conversion CoCo bail-in with three different scenarios
4. Write-down and Write-off CoCo bail-in

In the no bail-out/bail-in case, the firm follows the absolute priority rule (APR) where the equityholders bear all the loss before the bondholders become the residual claimant once the firm becomes insolvent. With the government bail-out the APR is still followed, however the government injects capital to ensure that the minimum capital ratio is attained, which results in the bondholders' position being guaranteed. With the equity-conversion CoCo bonds, the bail-in is triggered when the capital ratio is below a trigger level, in which case a necessary amount of the bond is converted into equity to attain the minimum capital ratio. This represents a deviation from absolute priority rule (DAPR). The write-down and write-off CoCo bail-in are the more extreme cases of DAPR, where the CoCo bonds are partially (write-down) or wholly (write-off) written down to cover the loss.

The three different scenarios in 3. arise from what happens once CoCo bonds are exhausted (the loss is larger than the face value of the CoCo bonds). More specifically, we consider the cases of: (i) no further bail-out/in, (ii) government bail-out, and (iii) forced bail-in of vanilla bonds. With the write-down and write-off CoCo bail-in, we simply assume forced bail-in of vanilla bonds once the CoCo bonds are exhausted.

5.1.1 Set-up

We consider a simple firm financed by common equity capital and discount bonds (vanilla or CoCo) with maturity T . The total face value of the bonds is F , which may include equity-conversion CoCo bond (face value F_C) or write-down/off CoCo bond (face value F_W). The face value of the plain vanilla bond is F_B . Therefore the firm can either have $F = F_B$ (no bail-out/in or government bail-out cases), $F = F_B + F_C$ (equity-conversion CoCo bond bail-in cases) or $F = F_B + F_W$ (write-down or write-off bond bail-in cases). The equity value at time 0 is E_0 . The total asset value at time T is V_T . All bail-outs / bail-ins trigger at the trigger capital ratio τ . There exists a minimum capital ratio \underline{E} set by the regulator, where $\underline{E} > \tau$. In all cases, where possible, when bailed-out/in the equity is boosted to this minimum capital ratio \underline{E} . In the following analysis, for the numerical examples the following parameter values are used when relevant: $F = 90$, $F_C = 20$, $F_W = 20$, $\tau = 7\%$ and $\underline{E} = 10\%$. The initial equity value is $E_0 = 20$ and the initial asset value is $V_0 = 110$.

5.1.2 Assumptions

For the purpose of this analysis, we make following two assumptions:

1. For the main body of this section, we review the payoff structure and the solvency of

the firm at the bond maturity T .

2. Where government bail-out is required, this will be done by common equity.

Both of these assumptions are relaxed in Section 5.1.8, where the firm is reviewed at $t \leq T$ and preference share bail-out is considered.

5.1.3 No Bail-out/in

This is the standard case of absolute priority rule (APR), where at the bond maturity T the initial losses are borne by the equityholders, and the bondholders become the residual claimant once the equityholders are wiped out. The table below outlines the payoffs to both the bondholders (D_B) and the equityholders (E_E) at time T depending on the values of V_T :

V_T	$[0, F)$	$[F, F + E_0)$	$[F + E_0, \infty]$
D_B	V_T	F	
E_E	0	$V_T - F$	
Total Firm	V_T	V_T	
Capital Ratio	0	$\left(0, \frac{E_0}{F + E_0}\right)$	$\left(\frac{E_0}{F + E_0}, 1\right)$
Notes	Capital wiped out, debt written down	Capital written down	Growth

(5.1)

For example for values of $V_T \in [F, F + E_0)$, the value of the firm is less than V_0 and hence the equityholders' payoff $E_E = V_T - F$ is less than E_0 .

It is well established in the literature that the equityholders hold a long call option

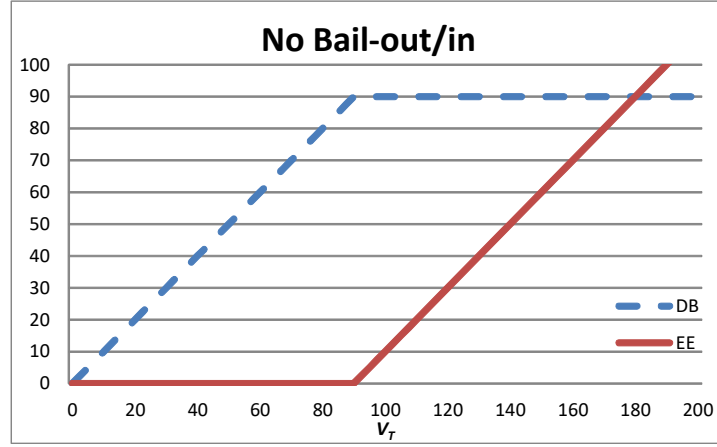


Figure 5.1: Payoffs for Original Equityholders: No Bail-out/in: $F = 90$

at strike price F , while the bondholders' position is the bond minus a put option of the same strike price. Their payoffs are,

$$\begin{aligned} D_B^N &= \min[V_T, F] \\ E_E^N &= \max[V_T - F, 0]. \end{aligned} \tag{5.2}$$

The superscript N represents the case of no bail-out / bail-in. Fig.5.1 depicts these payoffs for the example with $F = 90$. The Black-Scholes-Merton valuation of the debt and equity holdings at time $t = 0$ are,⁹

$$\begin{aligned} V_{D_B}^N &= Fe^{-rT} - P(F) \\ V_{E_E}^N &= C(F) \end{aligned} \tag{5.3}$$

⁹See for example Merton (1974).

where $C(K)$ and $P(K)$ are the prices of call and put options with strike price K ,

$$\begin{aligned}
C(K) &= V_0 N(d_1(K)) - Ke^{-rT} N(d_2(K)) \\
P(K) &= -V_0 N(-d_1(K)) + Ke^{-rT} N(-d_2(K)) \\
\text{with } d_1(K) &= \frac{\ln\left(\frac{V_0}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}, \quad d_2(K) = d_1 - \sigma\sqrt{T},
\end{aligned} \tag{5.4}$$

and r is the risk-free rate, T is the bond's time to maturity and σ is the asset volatility.

5.1.4 Government Bail-out

Next consider the case of government bail-out. This is assumed to be triggered when the capital ratio is less than τ . The bail-out occurs in the form of an injection of common shares E_G .¹⁰ As a result the balance sheet is restored to the level where the minimum capital ratio \underline{E} is reattained. With the bondholders fully protected at their face value F , this would be $V = \frac{F}{1-\underline{E}}$.

As with the no bail-out/in case, we investigate the stakeholders' payoffs for different outcomes of V_T . For $V_T > F + E_0$, the balance sheet has expanded, while for $\frac{F}{1-\tau} \leq V_T < F + E_0$, the equityholders bear the loss according to the APR. In both cases, the bondholders receive their face value back and the equityholders receive the rest ($D_B = F$ and $E_E = V_T - F$). If V_T turns out to be less than $\frac{F}{1-\tau}$, then the capital ratio is below τ and the government bail-out is triggered. As stated, with the external capital injection of E_G the balance sheet is restored to $\frac{F}{1-\underline{E}}$, and the equity capital to $\frac{\underline{E}}{1-\underline{E}}F$. The original equityholders still bear all of the loss and thus $E_E = V_T - F$, while the government's share

¹⁰The case for preference share injection is explored in Section 5.1.8.

of capital is $E_G = \frac{\underline{E}}{1-\underline{E}}F - (V_T - F) = \frac{F}{1-\underline{E}} - V_T$, which equals the amount the balance sheet is boosted by. For example when $V_T = 95$, with the loss $V_0 - V_T = 110 - 95 = 15$ wholly borne by the equityholders, E_E is reduced to $E_0 - (V_0 - V_T) = 20 - 15 = 5$. Without a bail-out the capital ratio $\frac{E_E}{V_T} = \frac{5}{95} = 5.26\%$ is below the trigger level $\tau = 7\%$, and therefore the government injects common equity $E_G = \frac{F}{1-\underline{E}} - V_T = \frac{90}{1-0.10} - 95 = 5$ to restore the balance sheet back up to $\frac{F}{1-\underline{E}} = 100$ and the capital ratio to $\frac{E_E+E_G}{F/(1-\underline{E})} = \frac{5+5}{100} = 10\% = \underline{E}$. The bondholders are unaffected with $D_B = 90$.

For $V_T \leq F$, the original equityholders' position is wiped out. The government continues to bail out the bondholders, with the taxpayers bearing the remaining loss.

The different scenarios of payoffs are summarised in the following table:

V_T	$[0, F)$	$[F, \frac{F}{1-\tau})$	$[\frac{F}{1-\tau}, F + E_0)$	$[F + E_0, \infty]$
D_B	F	F	F	
E_E	0	$V_T - F$	$V_T - F$	
E_G	$\frac{\underline{E}}{1-\underline{E}}F$	$\frac{F}{1-\underline{E}} - V_T$	0	
Total Firm	$\frac{F}{1-\underline{E}}$	$\frac{F}{1-\underline{E}}$	V_T	
Tax payers	$-(F - V_T)$	0	0	
Capital Ratio	\underline{E}	\underline{E}	$[\tau, \frac{E_0}{F+E_0})$	$[\frac{E_0}{F+E_0}, 1)$
Notes	E_E wiped out. Govt injects E_G to attain \underline{E} . Taxpayers bear remaining loss.	E_E written down. Capital ratio $< \tau$. Govt injects E_G to restore \underline{E} .	E_E written down. Capital ratio $\geq \tau$.	Growth

(5.5)

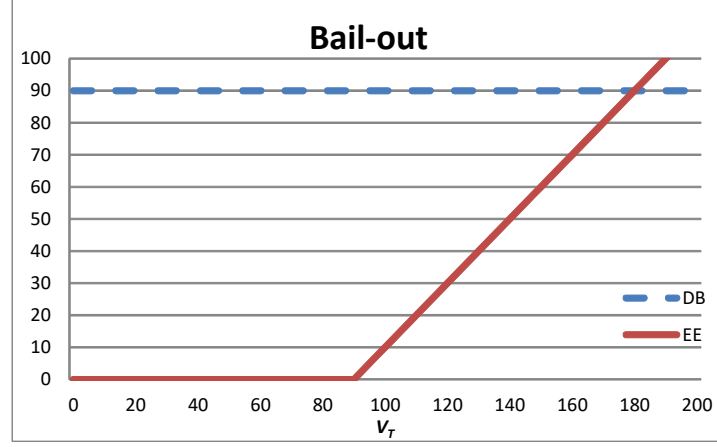


Figure 5.2: Payoffs for Original Equityholders: Government Bail-out: $F = 90$, $\underline{E} = 10\%$

These payoffs can be summarised as,

$$\begin{aligned}
 D_B^{BO} &= F \\
 E_E^{BO} &= \max[V_T - F, 0] \\
 E_G^{BO} &= \left(\frac{\underline{E} - \tau}{1 - \underline{E}} \right) \frac{F}{1 - \tau} \chi_{V_T \leq \frac{F}{1 - \tau}} + \left(\max \left[\frac{F}{1 - \tau} - V_T, 0 \right] - \max[F - V_T, 0] \right),
 \end{aligned} \tag{5.6}$$

where $\chi_{V_T \leq \frac{F}{1 - \tau}} = \begin{cases} 1 & \text{if } V_T \leq \frac{F}{1 - \tau} \\ 0 & \text{if } V_T > \frac{F}{1 - \tau} \end{cases}$ is an indicator function. This represents the capital injection required to boost the capital ratio from τ to \underline{E} . Fig.5.2 depicts the payoffs of the bondholders and the equityholders, the BSM valuation of which are,

$$\begin{aligned}
 V_{DB}^{BO} &= F e^{-rT} \\
 V_{EE}^{BO} &= C(F),
 \end{aligned} \tag{5.7}$$

Comparing Eq.(5.7) with Eq.(5.3) suggests that the government bail-out provides a put option $P(F)$ to the bondholders, *but the equityholders gain no benefit from the bail-out*. This is only so as we are currently considering the payoffs at the bond maturity T . Section 5.1.8 relaxes this assumption and considers the case where the firm's solvency is reviewed

at $t \leq T$, in which case the equityholders also benefit from the bail-out in cases where the firm is otherwise insolvent.

5.1.5 Equity-conversion CoCo Bail-in

Next we consider bail-in by equity-conversion contingent convertible (CoCo) bonds. As with the bail-out case, the bail-in is triggered when the capital ratio falls below τ to restore the ratio to the minimum capital ratio \underline{E} . However in contrast to the government bail-out, there is no external capital injection and therefore the balance sheet remains depleted.

The pre-trigger scenarios are the same as before: when $V_T \geq F + E_0$, the balance sheet has expanded, while when $\frac{F}{1-\tau} \leq V_T < V_0$, the equityholders bear all of the loss. In both cases, therefore, $D_B = F$ and $E_E = V_T - F$.

For $V_T < \frac{F}{1-\tau}$ the CoCo would be triggered. Then,

- The equityholders take the loss up to τV_T .
- With the minimum capital ratio requirement of \underline{E} , the CoCo bond is partially or wholly converted to make up the remaining required capital of $E_C = (\underline{E} - \tau) V_T$.
- When there is enough CoCo bond to cover the loss, then $D_C = (1 - \underline{E}) V_T - F_B$ (the total debt level minus the plain vanilla bond) of the CoCo bond is left unconverted. As a result the CoCo bondholders bear the loss equal to $F_C - (E_C + D_C) = F - (1 - \tau) V_T$.

This would be the case when there is enough CoCo bond to cover the loss, i.e. $D_C \geq 0 \Leftrightarrow V_T \geq \frac{F_B}{1-\underline{E}}$. To demonstrate, take the example of $V_T = 80$ where the firm loses 30. Without the bail-in the equityholders are wiped out. They bear the loss up to the trigger point, i.e. $E_C = \tau V_T = 80 \times 7\% = 5.6$, implying a loss of $E_0 - E_E = 20 - 5.6 = 14.4$. The CoCo bond is partially converted to make up the shortfall for the minimum capital ratio, and therefore $E_C = (\underline{E} - \tau) V_T = (0.1 - 0.07) \times 80 = 2.4$. This leaves $D_C = (1 - \underline{E}) V_T - F_B = (1 - 0.1) \times 80 - 70 = 2$ of the CoCo bond unconverted, so the CoCo bondholders bear the loss of $F_C - (D_C + E_C) = 20 - (2 + 2.4) = 15.6$. The plain vanilla bondholders are unaffected.

For $V_T < \frac{F_B}{1-\tau}$, even with the whole conversion of the CoCo bond the minimum equity ratio cannot be attained. For example when $V_T = 76 < \frac{F_B}{1-\tau} = \frac{70}{1-0.10} = 77.78$, the firm loses $V_0 - V_T = 110 - 76 = 34$. As before the equityholders bear the loss up to $E_E = \tau V_T = 76 \times 7\% = 5.32$, with a loss of $E_0 - E_E = 20 - 5.32 = 14.68$. The CoCo bond is converted in its entirety into $E_C = V_T - (E_E + D_B) = 76 - (70 + 5.32) = 0.68$ of equity, and therefore they bear the loss of $F_C - E_C = 20 - 0.68 = 19.32$. The capital ratio $\frac{E_E + E_C}{V_T} = \frac{5.32 + 0.68}{96} = 7.89\%$ is now below the minimum capital ratio of 10%; however the firm is unable to attain this even with the full conversion. This would be the case as long as $V_T \geq \frac{F_B}{1-\tau}$, when $E_C = (1 - \tau) V_T - F_B \geq 0$.

For $V_T < \frac{F_B}{1-\tau}$ the CoCo bond is wiped out, i.e. $D_C = E_C = 0$. There are now different scenarios that can be considered. We consider three of these. We could insist on the APR to be reinstated and write-down the equityholders' capital E_E . This would be analogous to the no bail-out/in case in Section 5.1.3. Alternatively, as with the bail-out case in Section 5.1.4, we could assume that the government would step in to inject common equity. Finally, we could assume that the regulator will exercise its bail-in power to force conversion of necessary amount of plain vanilla debt, such that the minimum capital ratio is again reattained. This would correspond to a repeat of the equity conversion bail-in just described in this section. Note in this case, any unsecured bond is inherently an equity-conversion CoCo bond.

Case 1: Bail-in-No-bail-out/in

In this case, for $F_B \leq V_T < \frac{F_B}{1-\tau}$ the equity E_E is written-down, while for $V_T < F_B$, the bondholders become the residual claimants. In summary,

V_T	$[0, F_B)$	$[F_B, \frac{F_B}{1-\tau})$	$[\frac{F_B}{1-\tau}, \frac{F_B}{1-\underline{E}}]$	$(\frac{F_B}{1-\underline{E}}, \frac{F}{1-\tau}]$	$(\frac{F}{1-\tau}, F + E_0)$	$[F + E_0, \infty]$
D_B	V_T	F_B	F_B	F_B	F_B	F_B
D_C	0	0	0	$(1-\underline{E})V_T - F_B$	F_C	F_C
E_E	0	$V_T - F_B$	τV_T	τV_T	$V_T - F$	$V_T - F$
E_C	0	0	$(1-\tau)V_T - F_B$	$(\underline{E} - \tau)V_T$	0	0
Total Firm	V_T	V_T	V_T	V_T	V_T	V_T
Capital ratio	0	$[0, \tau]$	$[\tau, \underline{E}]$	\underline{E}	$[\tau, \frac{E_0}{F+E_0})$	$[\frac{E_0}{F+E_0}, 1)$
Notes	E_E wiped out, debt-holders residual claimants	E_E written down	CoCo wholly triggered, \underline{E} unattainable	CoCo partially triggered	E_E written down. Capital ratio $\geq \tau$.	Growth

(5.8)

The payoffs for bondholders, the original equityholders and the CoCo bondholders are, where the CoCo bondholders' payoff is the total of their bond and equity positions,¹¹

$$\begin{aligned}
D_B^{CN} &= \min[V_T, F_B] \\
E_E^{CN} &= \max[V_T - F, 0] + \left\{ (1-\tau) \max\left[\frac{F}{1-\tau} - V_T, 0\right] - \max[F - V_T, 0] \right\} \\
&\quad - \left\{ (1-\tau) \max\left[\frac{F_B}{1-\tau} - V_T, 0\right] - \max[F_B - V_T, 0] \right\} \\
D_C^{CN} + E_C^{CN} &= F_C - (1-\tau) \left(\max\left[\frac{F}{1-\tau} - V_T, 0\right] - \max\left[\frac{F_B}{1-\tau} - V_T, 0\right] \right).
\end{aligned} \tag{5.10}$$

Fig.5.3 shows the bondholders' and equityholders' payoffs. The BSM valuation of these are,

¹¹The CoCo bondholders' respective positions in bond and equity are:

$$\begin{aligned}
D_C^{CN} &= (1 - \underline{E}) \left(\max\left[V_T - \frac{F_B}{1-\underline{E}}, 0\right] - \max\left[V_T - \frac{F}{1-\tau}, 0\right] \right) + \left(\frac{\underline{E} - \tau}{1-\tau} \right) F \chi_{V_T \geq \frac{F}{1-\tau}} \\
E_C^{CN} &= (1 - \tau) \max\left[V_T - \frac{F_B}{1-\tau}, 0\right] - (1 - \underline{E}) \max\left[V_T - \frac{F_B}{1-\underline{E}}, 0\right] - (\underline{E} - \tau) \max\left[V_T - \frac{F}{1-\tau}, 0\right] \\
&\quad - \left(\frac{\underline{E} - \tau}{1-\tau} \right) F \chi_{V_T \geq \frac{F}{1-\tau}}.
\end{aligned} \tag{5.9}$$

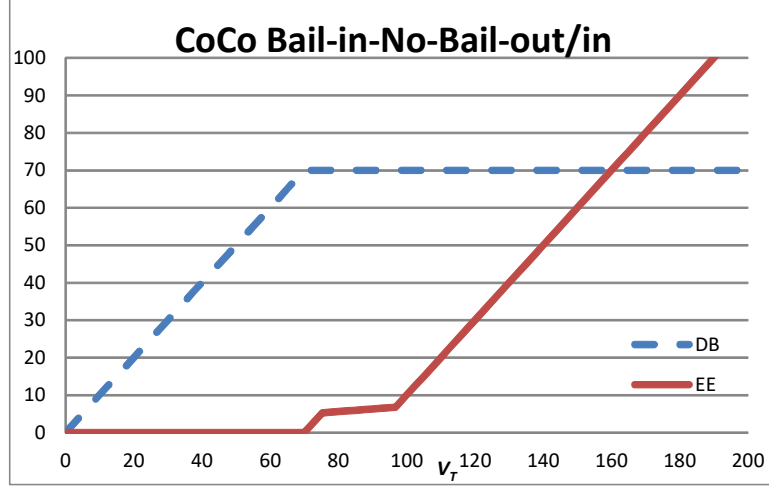


Figure 5.3: Payoffs for Original Equityholders: Equity-conversion Bail-in-No-Bail-out/in: $\tau = 7\%$, $\underline{E} = 10\%$, $F_B = 90$ and $F_C = 20$

$$\begin{aligned}
 V_{DB}^{CN} &= F_B e^{-rT} - P(F_B) \\
 V_{EE}^{CN} &= C(F) + \left[(1-\tau) P\left(\frac{F}{1-\tau}\right) - P(F) \right] - \left[(1-\tau) P\left(\frac{F_B}{1-\tau}\right) - P(F_B) \right] \\
 V_{EC}^{CN} + V_{DC}^{CN} &= F_C e^{-rT} - (1-\tau) \left[P\left(\frac{F}{1-\tau}\right) - P\left(\frac{F_B}{1-\tau}\right) \right].
 \end{aligned} \tag{5.11}$$

Note, we recover V_{DB}^N and V_{EB}^N when $\tau = F_C = 0$. V_{EE}^{CN} derived in Eq.(5.11) differs from the expression for “Convert-to-surrender CoCo” in Berg and Kaserer (2011) in two ways. First, they assume 100% conversion of the CoCo bond when triggered. Here we allow partial conversion. Second, they assume the whole liability to be CoCo bonds, i.e. $F = F_C$, and therefore the equityholders are never wiped out for $V_T > 0$. Here our assumption of $F_C < F$ means that, once the CoCo bond is wiped out, the normal practice of APR resumes where the equityholders’ holdings are written down ahead of the vanilla bonds.

One way of viewing the CoCo bail-in effect is to regard the difference between V_{EE}^{CN} in Eq.(5.11) and V_{EE}^N in Eq.(5.3) as the wealth-transfer induced by the introduction of deviation from absolute priority rule (DAPR). Diagrammatically, this is the area between the E_E payoff in Fig.5.3 and the normal call option payoff in Fig.5.1. Eberhart and Senbet (1993) also investigate the role of APR violations in reducing agency conflicts between bondholders and shareholders. However they assume the wealth-transfer to be a constant

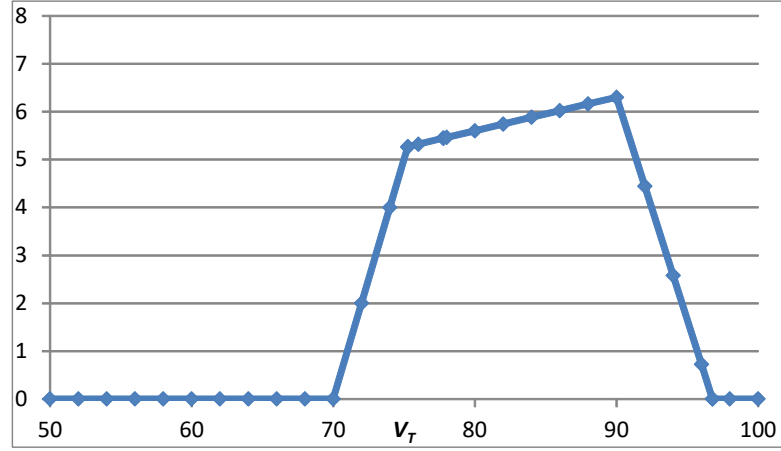


Figure 5.4: CoCo Condor: Bail-in-No-Bail-out/in

proportion of the firm value, and argue that when the firm is in distress the negative vega of the assumed wealth-transfer partly offsets the positive vega of the equityholders' position, hence mitigating the agency cost incentive. Here we are able to explicitly derive the amount of DAPR-induced wealth-transfer as $V_{EE}^{CN} - V_{EE}^N$:

$$V_{EE}^{CN} - V_{EE}^N = \left[(1 - \tau) P\left(\frac{F}{1 - \tau}\right) - P(F) \right] - \left[(1 - \tau) P\left(\frac{F_B}{1 - \tau}\right) - P(F_B) \right]. \quad (5.12)$$

Intuitively, the equityholders' payoff is improved by a bear spread-like protection, $(1 - \tau) P\left(\frac{F}{1 - \tau}\right) - P(F)$, which represents the DAPR induced by the introduction of the CoCo bond. The bull spread-like structure $-\left[(1 - \tau) P\left(\frac{F_B}{1 - \tau}\right) - P(F_B)\right]$ reinstates the APR once the CoCo bond is wiped out. Together they create a “condor-like” structure, which we will call the “*CoCo condor*”, depicted in Fig.5.4.¹²

¹²A *condor* is created by a combination of either a bull call spread with a bear call spread, or a bull put spread with a bear put spread. A *bull call spread* is formed by combining a long call option with a short call option of a higher strike price, such that the holder of the structure gains from a rise in the underlying asset price. In a *bear call spread*, the short call option has the lower strike price. Similarly for *bull* and *bear put spreads*.

Case 2: Bail-in-Bail-out

Here for $V_T < \frac{F_B}{1-\tau}$, with the capital ratio less than τ , the government bail-out is triggered with an injection of common equity E_G . Analogous to before, this boosts the balance sheet to $\frac{F_B}{1-\underline{E}}$ and the capital ratio to \underline{E} . The equityholders are wiped out for $V_T < F_B$, at which point the taxpayers are required to bear any remaining loss. In summary,

V_T	$[0, F_B)$	$[F_B, \frac{F_B}{1-\tau})$	$[\frac{F_B}{1-\tau}, \frac{F_B}{1-\underline{E}}]$	$(\frac{F_B}{1-\underline{E}}, \frac{F}{1-\tau})$	$(\frac{F}{1-\tau}, F + E_0)$	$[F + E_0, \infty]$
D_B	F_B	F_B	F_B	F_B	F_B	F_B
D_C	0	0	0	$(1-\underline{E})V_T - F_B$	F_C	F_C
E_E	0	$V_T - F_B$	τV_T	τV_T	$V_T - F$	$V_T - F$
E_C	0	0	$(1-\tau)V_T - F_B$	$(\underline{E} - \tau)V_T$	0	0
E_G	$\frac{\underline{E}}{1-\underline{E}}F_B$	$\frac{F_B}{1-\underline{E}} - V_T$	0	0	0	0
Total Firm	$\frac{F_B}{1-\underline{E}}$	$\frac{F_B}{1-\underline{E}}$	V_T	V_T	V_T	V_T
Tax payers	$-(F_B - V_T)$	0	0	0	0	0
Capital ratio	\underline{E}	\underline{E}	$[\tau, \underline{E}]$	\underline{E}	$[\tau, \frac{E_0}{F+E_0})$	$[\frac{E_0}{F+E_0}, 1)$
Notes	E_E wiped out. Govt injects E_G to restore \underline{E} . Taxpayers bear remaining loss.	E_E written down. Govt injects E_G to restore \underline{E} .	CoCo wholly triggered, \underline{E} unattainable	CoCo partially triggered	E_E written down. Capital ratio $\geq \tau$.	Growth

(5.13)

The payoffs for bondholders, equityholders, CoCo bondholders and the government

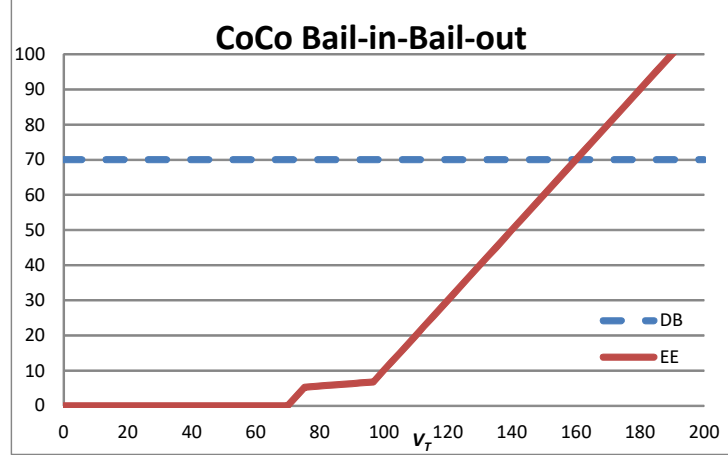


Figure 5.5: Payoffs for Original Equityholders: Equity-conversion Bail-in-Bail-out: $\tau = 7\%$, $\underline{E} = 10\%$, $F_B = 90$ and $F_C = 20$

are,

$$\begin{aligned}
 D_B^{CBO} &= F_B \\
 E_E^{CBO} &= \max[V_T - F, 0] + \left\{ (1 - \tau) \max\left[\frac{F}{1 - \tau} - V_T, 0\right] - \max[F - V_T, 0] \right\} \\
 &\quad - \left\{ (1 - \tau) \max\left[\frac{F_B}{1 - \tau} - V_T, 0\right] - \max[F_B - V_T, 0] \right\} \\
 D_C^{CBO} + E_C^{CBO} &= F_C - (1 - \tau) \left(\max\left[\frac{F}{1 - \tau} - V_T, 0\right] - \max\left[\frac{F_B}{1 - \tau} - V_T, 0\right] \right) \\
 E_G^{CBO} &= \left(\frac{\underline{E} - \tau}{1 - \underline{E}} \right) \frac{F_B}{1 - \tau} \chi_{V_T \leq \frac{F_B}{1 - \tau}} + \left(\max\left[\frac{F_B}{1 - \tau} - V_T, 0\right] - \max[F_B - V_T, 0] \right).
 \end{aligned} \tag{5.14}$$

Fig.5.5 shows the bondholders' and equityholders' payoffs. The equityholders' payoff is the same as in Fig.5.3, as discussed in Section 5.1.4. The vanilla bondholders' position is guaranteed at F . The BSM valuations for the original equity and bondholders are,¹³

$$\begin{aligned}
V_{D_B}^{CBO} &= F_B e^{-\tau T} \\
V_{E_E}^{CBO} &= C(F) + \left[(1 - \tau) P\left(\frac{F}{1 - \tau}\right) - P(F) \right] - \left[(1 - \tau) P\left(\frac{F_B}{1 - \tau}\right) - P(F_B) \right] \\
V_{E_C}^{CBO} + V_{D_C}^{CBO} &= F_C e^{-\tau T} - (1 - \tau) \left[P\left(\frac{F}{1 - \tau}\right) - P\left(\frac{F_B}{1 - \tau}\right) \right].
\end{aligned} \tag{5.15}$$

The equityholders again benefit from the CoCo condor in Eq.(5.12).

Case 3: Bail-in-Bail-in

Finally in this case, when even with the CoCo bond wholly wiped out the capital ratio is otherwise below τ , the vanilla bondholders bail-in the equityholders by forced conversion to reattain the minimum capital ratio \underline{E} . Then the equityholders lose up to τV_T , the CoCo bond is wiped out ($D_C = E_C = 0$) thus bearing the loss of F_C , and $F_B - (1 - \underline{E}) V_T = F_B - D_B$ of vanilla bond is converted to $E_B = (\underline{E} - \tau) V_T$ of equity. The bondholders thus bear the loss of $[F_B - (1 - \underline{E}) V_T] - [(\underline{E} - \tau) V_T] = F_B - (1 - \tau) V_T$. Consider as an example $V_T = 60$, when the firm loses 50. Then $E_C = \tau V_T = 60 \times 7\% = 4.2$, so the equityholders lose $20 - 4.2 = 15.8$. The CoCo bondholders lose their entire position of $F_C = 20$. Further, $F_B - (1 - \underline{E}) V_T = 70 - 0.9 \times 60 = 16$ of the vanilla bond is converted to $E_B = (\underline{E} - \tau) V_T = (0.1 - 0.07) \times 60 = 1.8$ of equity, and therefore they bear the loss of $16 - 1.8 = 14.2$.

In summary,

¹³The CoCo bondholders' respective positions in bond and equity are the same as in the Bail-in-No-Bail-out/in case, i.e. $D_C^{CBO} = D_C^{CN}$ and $E_C^{CBO} = E_C^{CN}$.

V_T	$\left[0, \frac{F_B}{1-\tau}\right)$	$\left[\frac{F_B}{1-\tau}, \frac{F_B}{1-\underline{E}}\right]$	$\left(\frac{F_B}{1-\underline{E}}, \frac{F}{1-\tau}\right]$	$\left(\frac{F}{1-\tau}, F + E_0\right)$	$[F + E_0, \infty]$
D_B	$(1-\underline{E})V_T$	F_B	F_B	F_B	
D_C	0	0	$(1-\underline{E})V_T - F_B$	F_C	
E_E	τV_T	τV_T	τV_T	$V_T - F$	
E_C	0	$(1-\tau)V_T - F_B$	$(\underline{E} - \tau)V_T$	0	
E_B	$(\underline{E} - \tau)V_T$	0	0	0	
Total Firm	V_T	V_T	V_T	V_T	
Capital ratio	\underline{E}	$[\tau, \underline{E}]$	\underline{E}	$\left[\tau, \frac{E_0}{F+E_0}\right)$	$\left[\frac{E_0}{F+E_0}, 1\right)$
Notes	Forced bail-in by vanilla bondholders	CoCo wholly triggered, \underline{E} unattainable	CoCo partially triggered	E_E written down. Capital ratio $\geq \tau$.	Growth

(5.16)

The payoffs are,¹⁴

$$\begin{aligned}
D_B^{CBI} + E_B^{CBI} &= \min[(1-\tau)V_T, F_B] \\
E_E^{CBI} &= \max[V_T - F, 0] + \left\{ (1-\tau) \max\left[\frac{F}{1-\tau} - V_T, 0\right] - \max[F - V_T, 0] \right\} \\
D_C^{CBI} + E_C^{CBI} &= F_C - (1-\tau) \left(\max\left[\frac{F}{1-\tau} - V_T, 0\right] - \max\left[\frac{F_B}{1-\tau} - V_T, 0\right] \right).
\end{aligned} \tag{5.18}$$

Fig.5.6 shows the bondholders' and equityholders' payoffs. The BSM valuation of these are,

$$\begin{aligned}
V_{D_B}^{CBI} + V_{E_B}^{CBI} &= F_B e^{-rT} - (1-\tau) P\left(\frac{F_B}{1-\tau}\right) \\
V_{E_E}^{CBI} &= C(F) + \left[(1-\tau) P\left(\frac{F}{1-\tau}\right) - P(F) \right] \\
V_{E_C}^{CBI} + V_{D_C}^{CBI} &= F_C e^{-rT} - (1-\tau) \left[P\left(\frac{F}{1-\tau}\right) - P\left(\frac{F_B}{1-\tau}\right) \right].
\end{aligned} \tag{5.19}$$

¹⁴The CoCo bondholders' positions in bond and equity are the same as in the Bail-in-No-Bail-out/in case, i.e. $D_C^{CBI} = D_C^{CN}$ and $E_C^{CBI} = E_C^{CN}$. The vanilla bondholders' respective positions in bond and equity are:

$$\begin{aligned}
D_B^{CBI} &= F_B - (1-\underline{E}) \max\left[\frac{F_B}{1-\tau} - V_T, 0\right] - \left(\frac{\underline{E}-\tau}{1-\tau}\right) F_B \chi_{V_T \leq \frac{F_B}{1-\tau}} \\
E_B^{CBI} &= (\underline{E} - \tau) \left(\frac{F_B}{1-\tau} \chi_{V_T \leq \frac{F}{1-\tau}} - \max\left[\frac{F_B}{1-\tau} - V_T, 0\right] \right).
\end{aligned} \tag{5.17}$$

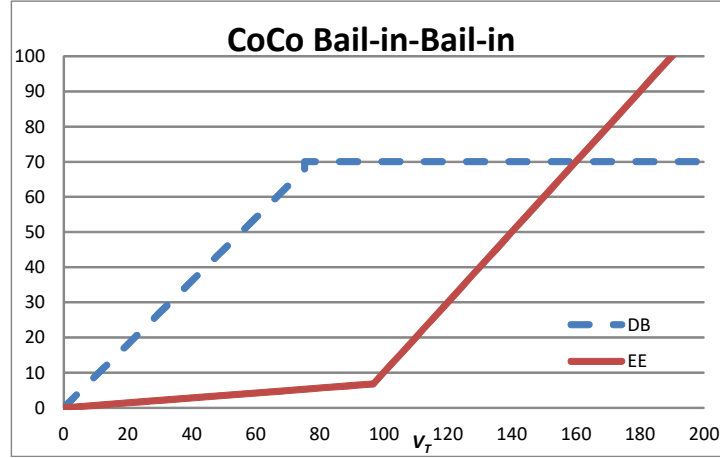


Figure 5.6: Payoffs for Original Equityholders: Equity-conversion Bail-in-Bail-in: $\tau = 7\%$, $\underline{E} = 10\%$, $F_B = 90$ and $F_C = 20$

Note that compared with Eq.(5.11), the equityholders now benefit from a bear spread-like protection $(1 - \tau) P\left(\frac{F}{1-\tau}\right) - P(F)$, rather than the CoCo condor in Eq.(5.12). This is due to the forced bail-in by the vanilla bond, that corresponds to a continued DAPR even after the CoCo bond is exhausted.

5.1.6 Write-down/off CoCo Bail-in

Finally, we consider bail-in by write-down / write-off CoCo bonds. Write-down bonds are only partially written-down when the trigger occurs, while the write-off bonds are immediately written-off in its entirety to cover the loss. There are unknowns as to what happens when these bonds are triggered. For the write-down bond, it is unclear how the firm reattains the minimum capital ratio \underline{E} after the trigger at τ . Here we assume a bail-in by the write-down bond holders (“write-down-bail-in”) such that $(\underline{E} - \tau) V_T$ of the write-down bond is converted one-to-one to a contingent capital reserve (CCR). For the write-off bond, it is unclear what happens to the remainder of the written-off bond when the write-off more than covers the firm’s loss. Here, again, it is assumed that the net amount becomes a CCR.

In both cases, the outcomes for $V_T \geq \frac{F}{1-\tau}$ when there is no trigger are equivalent

to the equity-conversion CoCo bail-in outcomes. We therefore consider the outcomes for $V_T < \frac{F}{1-\tau}$ for each type of bond, respectively.

Write-down-Bail-in

For write-down bonds the bond is written-off only partially. For example for $V_T = 80$, when the firm loses 30, the equityholders bear the loss of $E_0 - \tau V_T = 20 - 80 \times 0.07 = 14.4$. The write-down bond is triggered to cover the remaining loss of $30 - 14.4 = 15.6$. As it is, $D_W = 20 - 15.6 = 4.4$ would then remain untriggered. However, at this point the capital ratio is τ , below the minimum required ratio of \underline{E} . It is unclear what would happen in this case. Here, for the purpose of the comparison with the equity-conversion CoCo case, we assume a bail-in by the write-down bond that results in a 1-to-1 conversion of the required amount of the bond into common equity to make up the difference to $\underline{E}V_T$. Thus in this example $(\underline{E} - \tau)V_T = (0.1 - 0.07) \times 80 = 2.4$ is converted into a contingent capital reserve E_{CCR} . This leaves $D_W = 20 - 15.6 - 2.4 = 2$ as the unconverted write-down bond. Note this also equals $(1 - \underline{E})V_T - F_B = (1 - 0.1) \times 80 - 70 = 2$.

This bail-in scenario would be the case as long as $(1 - \underline{E})V_T > F_B \Leftrightarrow V_T > \frac{F_B}{1 - \underline{E}}$. For values of V_T below this the minimum capital ratio \underline{E} is not attainable even with a full write-down of the write-down bond. In this case we assume a forced bail-in by the vanilla bondholders, as with the equity-conversion CoCo bond bail-in-bail-in case above. Thus for $V_T = 70$, when the firm loses 40, then $E_E = \tau V = 70 \times 7\% = 4.9$ so the equityholders lose $E_0 - E_E = 20 - 4.9 = 15.1$. The write-off bondholders lose all of their 20. This still leaves $40 - 15.1 - 20 = 4.9$ of the loss to be covered, which is written down by the plain vanilla bondholders. There is further equity-conversion bail-in of $E_B = (\underline{E} - \tau)V_T = 70 \times (0.1 - 0.07) = 2.1$ to attain the required capital ratio \underline{E} . As a result, the vanilla bondholders are left with $D_B = 70 - 4.9 - 2.1 = 63$ of the bond.

In summary,

V_T	$\left[0, \frac{F_B}{1-\tau}\right)$	$\left[\frac{F_B}{1-\tau}, \frac{F_B}{1-\underline{E}}\right]$	$\left(\frac{F_B}{1-\underline{E}}, \frac{F}{1-\tau}\right]$	$\left(\frac{F}{1-\tau}, V_0\right)$	$[V_0, \infty]$
D_B	$(1-\underline{E})V_T$	F_B	F_B	F_B	
D_W	0	0	$(1-\underline{E})V_T - F_B$	F_W	
E_E	τV_T	τV_T	τV_T	$V_T - F$	
E_{CCR}	0	$(1-\tau)V_T - F_B$	$(\underline{E} - \tau)V_T$	0	
E_B	$(\underline{E} - \tau)V_T$	0	0	0	
Total Firm	V_T	V_T	V_T	V_T	
Capital ratio	\underline{E}	$[\tau, \underline{E}]$	\underline{E}	$\left[\tau, \frac{E_0}{F+E_0}\right)$	$\left[\frac{E_0}{F+E_0}, 1\right)$
Notes	Forced bail-in by vanilla bondholders	WD bond wholly written down. \underline{E} unattainable.	WD bond written down to cover loss and converted to attain \underline{E} .	E_E written down. Capital ratio $\geq \tau$.	Growth

(5.20)

It is unclear who claims the contingent capital reserve E_{CCR} . Importantly, if E_{CCR} remains with the write-down bondholders, then the above outcomes are identical to the equity-conversion bail-in-bail-in case in Section 5.1. We therefore assume here that the claim for E_{CCR} is transferred to the equityholders. In this case the payoffs can be

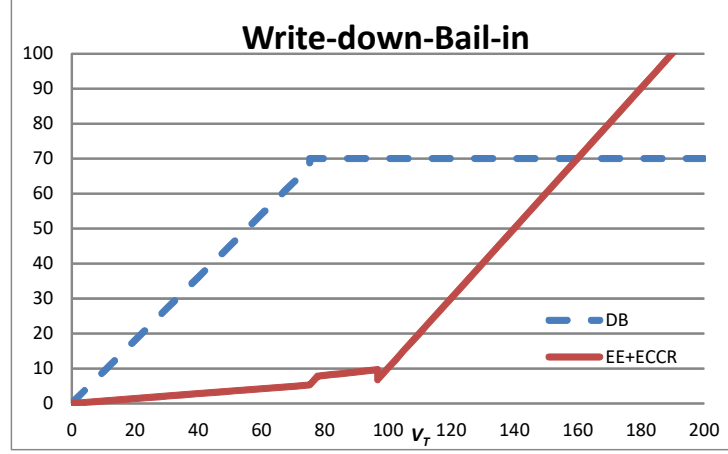


Figure 5.7: Payoffs for Original Equityholders: Write-down-Bail-in: $\tau = 7\%$, $\underline{E} = 10\%$, $F_B = 90$ and $F_W = 20$

summarised as,¹⁵

$$\begin{aligned}
 D_B^{WDBI} + E_B^{WDBI} &= \min[(1 - \tau) V_T, F_B] \\
 E_E^{WDBI} + E_{CCR}^{WDBI} &= V_T - F + \left(\frac{\underline{E} - \tau}{1 - \tau}\right) F \chi_{V_T \leq \frac{F}{1 - \tau}} + (1 - \underline{E}) \left(\max \left[\frac{F}{1 - \tau} - V_T, 0 \right] \right. \\
 &\quad \left. - \max \left[\frac{F_B}{1 - \underline{E}} - V_T, 0 \right] \right) + (1 - \tau) \max \left[\frac{F_B}{1 - \tau} - V_T, 0 \right] \\
 D_W^{WDBI} &= F_w - \left(\frac{\underline{E} - \tau}{1 - \tau}\right) F \chi_{V_T \leq \frac{F}{1 - \tau}} \\
 &\quad - (1 - \underline{E}) \left(\max \left[\frac{F}{1 - \tau} - V_T, 0 \right] - \max \left[\frac{F_B}{1 - \underline{E}} - V_T, 0 \right] \right). \tag{5.21}
 \end{aligned}$$

There is now a discontinuous jump in the payoff for the equityholders of $\left(\frac{\underline{E} - \tau}{1 - \tau}\right) F \chi_{V_T \leq \frac{F}{1 - \tau}}$, due to the transfer of the CCR to them. This is also demonstrated in Fig.5.7. The BSM

¹⁵As already noted this write-down-bail-in case is the redistribution of the equity-conversion bail-in-bail-in case, where the equity-converted portion of the CoCo bond E_C^{CBI} is now allocated to the equityholders as the contingent capital reserve E_{CCR}^{WDBI} . Therefore it is no surprise that $E_E^{WDBI} = E_E^{CBI}$, $E_{CCR}^{WDBI} = E_C^{CBI}$, $D_B^{WDBI} = D_B^{CBI}$ and $E_B^{WDBI} = E_B^{CBI}$.

valuation of these are,

$$\begin{aligned}
V_{D_B}^{WDBI} + V_{E_B}^{WDBI} &= F_B e^{-rT} - (1 - \tau) P\left(\frac{F_B}{1 - \tau}\right) \\
V_{E_E}^{WDBI} + V_{E_{CCR}}^{WDBI} &= C(F) + \left[(1 - \tau) P\left(\frac{F}{1 - \tau}\right) - P(F)\right] + (\underline{E} - \tau) \left[\frac{F}{1 - \tau} B_P\left(\frac{F}{1 - \tau}\right) \right. \\
&\quad \left. - P\left(\frac{F}{1 - \tau}\right)\right] - (1 - \underline{E}) P\left(\frac{F_B}{1 - \underline{E}}\right) + (1 - \tau) P\left(\frac{F_B}{1 - \tau}\right) \\
V_{D_W}^{WDBI} &= F_w e^{-rT} - \left(\frac{\underline{E} - \tau}{1 - \tau}\right) F B_P\left(\frac{F}{1 - \tau}\right) - (1 - \underline{E}) \left[P\left(\frac{F}{1 - \tau}\right) - P\left(\frac{F_B}{1 - \underline{E}}\right)\right].
\end{aligned} \tag{5.22}$$

where $B_C(K)$ and $B_P(K)$ are the price of the binary call and put options with unit payout at strike K ,

$$\begin{aligned}
B_C(K) &= e^{-rT} N(d_2(K)) \\
B_P(K) &= e^{-rT} N(-d_2(K)).
\end{aligned} \tag{5.23}$$

Write-off-Bail-in

The write-off bond differs from the write-down bond above in that the entire bond is written-off at once for values of $V_T < \frac{F}{1 - \tau}$. Then upon trigger immediately, $D_W = 0$. Any remainder net of the loss is then assumed to be added to the firm's capital as the contingency capital reserve. Consider again the example $V_T = 80$ when the firm loses 30. As before $E_E = \tau V_T = 80 \times 7\% = 5.6$ and so the equityholders bear the loss of $E_0 - E_E = 20 - 5.6 = 14.4$, and the write-off bond is triggered to cover the rest of the loss. Of $F_W = 20$, $30 - 14.4 = 15.6$ is required to write-off this loss, while the remaining $20 - 15.6 = 4.4$ is added to the equity capital as E_{CCR} . The capital ratio $\frac{E_E + E_{CCR}}{V_T} = \frac{V_T - F_B}{V_T} = \frac{80 - 70}{80} = 12.5\%$ is now above the minimum ratio \underline{E} . This would be true for values of V_T for which $\frac{V_T - F_B}{V_T} \geq \underline{E} \Leftrightarrow V_T \geq \frac{F_B}{1 - \underline{E}}$. For V_T below this level, we again assume forced bail-in by the vanilla bondholders, as was the case for both the equity-conversion bail-in-bail-in and the write-down-bail-in.

In summary then,

V_T	$\left[0, \frac{F_B}{1-\tau}\right)$	$\left[\frac{F_B}{1-\tau}, \frac{F_B}{1-\underline{E}}\right)$	$\left[\frac{F_B}{1-\underline{E}}, \frac{F}{1-\tau}\right)$	$\left[\frac{F}{1-\tau}, V_0\right)$	$[V_0, \infty]$
D_B	$(1-\underline{E})V_T$	F_B	F_B	F_B	
D_W	0	0	0	F_W	
E_E	τV_T	τV_T	τV_T	$V_T - F$	
E_{CCR}	0	$(1-\tau)V_T - F_B$	$(1-\tau)V_T - F_B$	0	
E_B	$(\underline{E}-\tau)V_T$	0	0	0	
Total Firm	V_T	V_T	V_T	V_T	
Capital ratio	\underline{E}	$[\tau, \underline{E}]$	\underline{E}	$\left[\tau, \frac{E_0}{F+E_0}\right)$	$\left[\frac{E_0}{F+E_0}, 1\right)$
Notes	Forced bail-in by vanilla bondholders	\underline{E} unattainable even with the CCR.	WO bond triggered. Remainder net of loss added as CCR. \underline{E} not breached.	E_E written down. Capital ratio $\geq \tau$.	Growth

(5.24)

As in the write-down-bail-in case, here we assume that the contingent capital reserve is transferred to the equityholders, although in reality it is unclear who would lay

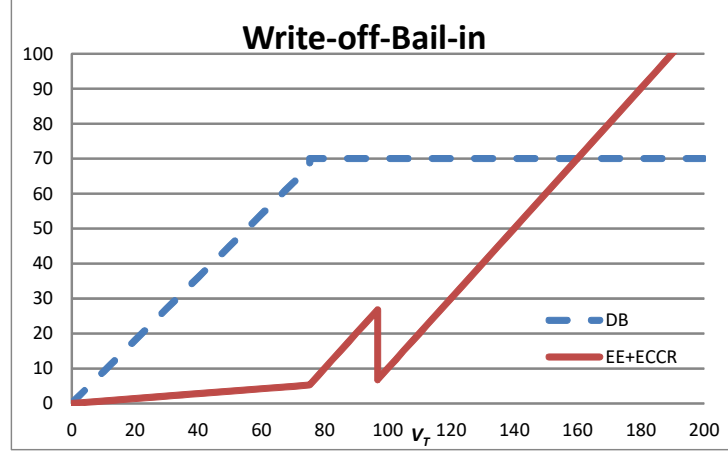


Figure 5.8: Payoffs for Original Equityholders: Write-down-Bail-in: $\tau = 7\%$, $\underline{E} = 10\%$, $F_B = 90$ and $F_W = 20$

the claim to this capital. Then the payoffs can be summarised as,¹⁶

$$\begin{aligned}
 D_B^{WOBI} + E_B^{WOBI} &= \min[(1 - \tau) V_T, F_B] \\
 E_E^{WOBI} + E_{CCR}^{WOBI} &= V_T - F + F_W \chi_{V_T \leq \frac{F}{1-\tau}} + (1 - \tau) \max\left[\frac{F_B}{1-\tau} - V_T, 0\right] \quad (5.26) \\
 D_W^{WOBI} &= F_W \chi_{V_T > \frac{F}{1-\tau}}
 \end{aligned}$$

Fig.5.8 shows the bondholders' and equityholders' payoffs. The BSM valuation of the debt

¹⁶For vanilla bondholders the payoffs are the same as in the equity-conversion bail-in-bail-in case, i.e. $D_B^{WOBI} = D_B^{CBI}$ and $E_B^{WOBI} = E_B^{CBI}$. For the equityholders, $E_E^{WOBI} = E_E^{CBI}$ and

$$E_{CCR}^{WOBI} = (1 - \tau) \left(\max\left[V_T - \frac{F_B}{1-\tau}, 0\right] - \max\left[V_T - \frac{F}{1-\tau}, 0\right] \right) - F_W \chi_{V_T \geq \frac{F}{1-\tau}} \quad (5.25)$$

and equity holdings at time $t = 0$ are,

$$\begin{aligned}
V_{DB}^{WOBI} + V_{EB}^{WOBI} &= F_B e^{-rT} - (1 - \tau) P\left(\frac{F_B}{1 - \tau}\right) \\
V_{EE}^{WOBI} + V_{ECCR}^{WOBI} &= C(F) + F_W B_P\left(\frac{F}{1 - \tau}\right) - \left[P(F) - (1 - \tau) P\left(\frac{F_b}{1 - \tau}\right)\right] \\
V_{DW}^{WOBI} &= F_w B_C\left(\frac{F}{1 - \tau}\right).
\end{aligned} \tag{5.27}$$

The equityholders' position $V_{EE}^{WOBI} + V_{ECCR}^{WOBI}$ in Eq.(5.27) differs from the expression for “Convert-to-steal CoCo” in Berg and Kaserer (2011), in that here the trigger point is at $\frac{F}{1 - \tau}$, and there is a forced bail-in by the vanilla bondholders at $\frac{F_B}{1 - \tau}$.

Analogous to the CoCo bail-in analysis, the difference between $V_{EE}^{WOBI} + V_{ECCR}^{WOBI}$ in Eq.(5.27) and V_{EE}^N in Eq.(5.3) represents the wealth-transfer induced by the introduction of DAPR:

$$\begin{aligned}
&\left(V_{EE}^{WOBI} + V_{ECCR}^{WOBI}\right) - V_{EE}^N \\
&= F_W B_P\left(\frac{F}{1 - \tau}\right) - \left[P(F) - (1 - \tau) P\left(\frac{F_b}{1 - \tau}\right)\right].
\end{aligned} \tag{5.28}$$

This we call a *Write-off condor*, shown in Fig.5.9.

5.1.7 Analysis

The BSM valuations of the equityholders' positions in Eqs.(5.3), (5.7), (5.11), (5.15), (5.19), (5.22) and (5.27) are summarised below, but with $C(F)$ replaced with $V_0 -$

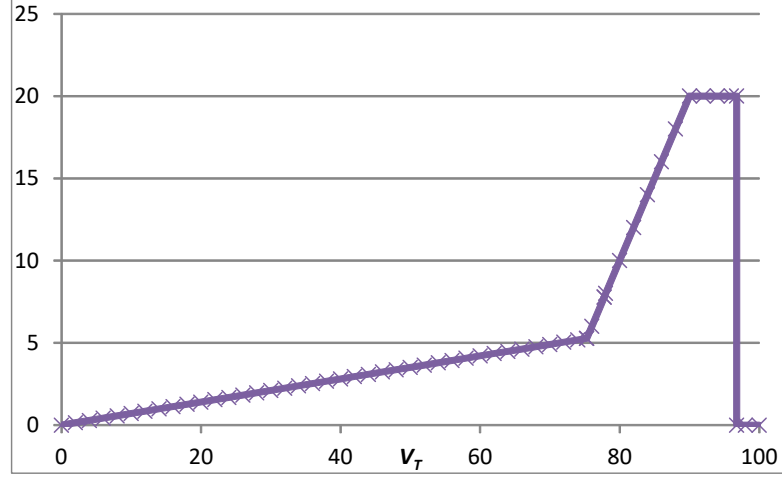


Figure 5.9: Write-off Condor: Write-off-Bail-in

$Fe^{-rT} + P(F)$:

No Bail-out/in	$V_0 - Fe^{-rT} + P(F)$
Bail-out	$V_0 - Fe^{-rT} + P(F)$
Bail-in-No-bail-out/in	$V_0 - Fe^{-rT} + (1 - \tau) P\left(\frac{F}{1-\tau}\right) - \left[(1 - \tau) P\left(\frac{F_B}{1-\tau}\right) - P(F_B)\right]$
Bail-in-Bail-out	$V_0 - Fe^{-rT} + (1 - \tau) P\left(\frac{F}{1-\tau}\right) - \left[(1 - \tau) P\left(\frac{F_B}{1-\tau}\right) - P(F_B)\right]$
Bail-in-Bail-in	$V_0 - Fe^{-rT} + (1 - \tau) P\left(\frac{F}{1-\tau}\right)$
Write-down-Bail-in	$V_0 - Fe^{-rT} + (1 - \tau) P\left(\frac{F}{1-\tau}\right) + (\underline{E} - \tau) \left[\frac{F}{1-\tau} B_P\left(\frac{F}{1-\tau}\right) - P\left(\frac{F}{1-\tau}\right) \right]$ $- (1 - \underline{E}) P\left(\frac{F_B}{1-\underline{E}}\right) + (1 - \tau) P\left(\frac{F_B}{1-\tau}\right)$
Write-off-Bail-in	$V_0 - Fe^{-rT} + \left[F_W B_P\left(\frac{F}{1-\tau}\right) + (1 - \tau) P\left(\frac{F_B}{1-\tau}\right) \right]$

(5.29)

Writing these in this way clarifies the protection each scheme offers to the equityholders.

For example in both the no-bail-out/in and bail-out cases the equityholders are protected by

the put option with strike price F . On the other hand with equity-conversion bail-in-bail-in,

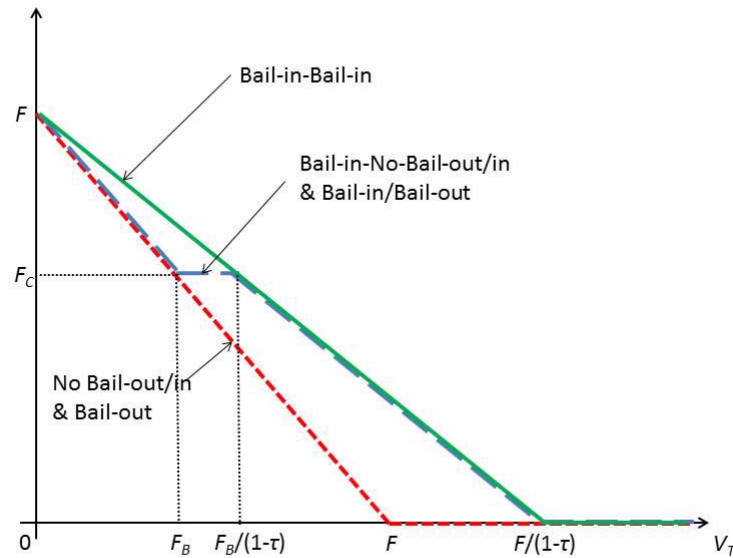


Figure 5.10: Equityholders' Protections for No Bail-out/in, Government Bail-out and Equity-conversion Bail-in

the equityholders' protection is by $1 - \tau$ of a put option with a higher strike price $\frac{F}{1 - \tau}$. These protections are plotted respectively in Figs 5.10 and 5.11. They clearly demonstrate the increasing protection for the equityholders in the order of (i) no bail-out/in and bail-out, (ii) bail-in-no-bail-out/in and bail-in-bail-out, (iii) bail-in-bail-in, (iv) write-down-bail-in, and (v) write-off-bail-in. In other words at each step, there is an extra incremental “put-spread” or “condor-like ” option structure inherently sold by the bail-out / bail-in providers to the equityholders. These lead to increasing agency costs, as discussed in Sections 5.2 and 5.3.

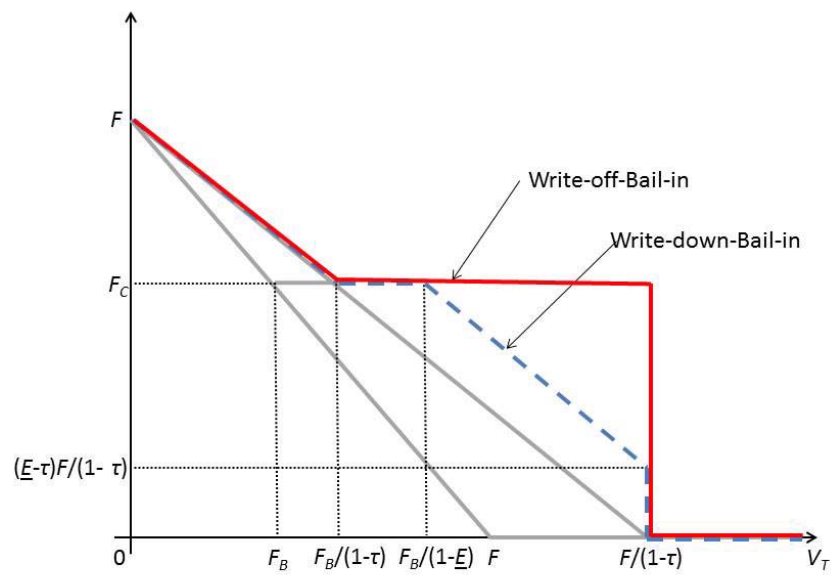


Figure 5.11: Equityholders' Protections for Write-down-Bail-in and Write-off-Bail-in

5.1.8 Extensions

Valuation before Bond Maturity

As discussed in Section 5.1.4, the government bail-out provides no benefit to equityholders at bond maturity. This is not the case before maturity $t < T$, where the bail-out enables the firm to continue operating as going-concern in cases where the firm would otherwise become gone-concern. This provides the equityholders with a strictly positive time value of the continuing option, which is the benefit of the bail-out to the equityholders.

To demonstrate this, consider an inspection by the regulator at time $t < T$. Assume that in the case of no bail-out/in the firm is closed down if its capital ratio is below the minimum equity ratio \underline{E} , i.e. $V_t < \frac{F}{1-\underline{E}}$. In this case the value of the equityholders' position at t is,

$$V_{E_E}^N = \begin{cases} \max[V_t - F, 0] & \text{if } V_t < \frac{F}{1-\underline{E}} \\ C(V_t, F, r, \sigma, T - t) & \text{if } V_t \geq \frac{F}{1-\underline{E}} \end{cases}, \quad (5.30)$$

where $C(S, K, r, \sigma, s)$ is the price of a call option given by (5.4), with the price of the underlying asset S , strike price K , continuously compounding interest rate r , volatility σ and the time to maturity s . The payoff reflects the fact that when the capital ratio is below \underline{E} and the firm is forced to close, the equityholders are left with the intrinsic value of the call option. This is not the case when there is government bail-out:

$$V_{E_E}^{BO} = \begin{cases} \frac{\max[V_t - F, 0]}{\frac{\underline{E}}{1-\underline{E}}F} C\left(\frac{F}{1-\underline{E}}, F, r, \sigma, T - t\right) & \text{if } V_t < \frac{F}{1-\underline{E}} \\ C(V_t, F, r, \sigma, T - t) & \text{if } V_t \geq \frac{F}{1-\underline{E}} \end{cases}. \quad (5.31)$$

Upon inspection, if the capital ratio is less than \underline{E} the government injects common equity

E_G to boost the asset value to $\frac{F}{1-\underline{E}}$. The total equity $E_E + E_G$ is then $\frac{\underline{E}}{1-\underline{E}}F$. The market value of this total equity is $C\left(\frac{F}{1-\underline{E}}, F, r, \sigma, T-t\right)$, with the equityholders holding a share $\frac{\max[V_t-F, 0]}{\frac{\underline{E}}{1-\underline{E}}F}$ of it. This represents the dilution resulting from the common equity capital injection. Now $V_E^{BO} > V_E^N$ unambiguously as,

$$\begin{aligned} \frac{\max[V_t-F, 0]}{\frac{\underline{E}}{1-\underline{E}}F} C\left(\frac{F}{1-\underline{E}}, F, r, \sigma, T-t\right) &> \max[V_t-F, 0] \\ \Leftrightarrow C\left(\frac{F}{1-\underline{E}}, F, r, \sigma, T-t\right) &> \frac{\underline{E}}{1-\underline{E}}F, \end{aligned} \quad (5.32)$$

where $\frac{\underline{E}}{1-\underline{E}}F = \frac{F}{1-\underline{E}} - F$ is the intrinsic value of $C\left(\frac{F}{1-\underline{E}}, F, r, \sigma, T-t\right)$. This clearly illustrates the equityholders' benefit from the government bail-out, which is their share $\frac{\max[V_t-F, 0]}{\frac{\underline{E}}{1-\underline{E}}F}$ of the time value of the continuing call option $C\left(\frac{F}{1-\underline{E}}, F, r, \sigma, T-t\right) - \frac{\underline{E}}{1-\underline{E}}F$.

Preference Share

So far the government bail-out has been assumed to be conducted by an injection of common equity only. Here we extend this to include preference shares¹⁷ injection. We assume a minimum common equity floor $\underline{E}_C < \underline{E}$, such that the government's preference shares E_P are utilised to attain the minimum capital ratio \underline{E} , while the government's

¹⁷The Bail-Out scheme worked differently between US and Europe through out the Financial Crisis. The former resorted, in most cases to, preference shares (no dilution to equityholders) to bolster capitalisation across the banking system (Goldman Sachs, Morgan Stanley, Citigroup etc) that were swiftly reimbursed to the government as the banks restored profitability and raised private equity. In Europe however, unless the bank was not viable (and hence put into resolution), the regulators adopted the injection of common equity (Lloyds, RBS, KBC etc) to replenish capitalisation and steered cleared of preference shares to dilute existing shareholders and lower the taxpayer burden. While both schemes were meant to prop up the banking system and mitigate the deepening of the financial crisis, the US model definitely illustrates the traditional moral hazard embedded in the banking system in which shareholders run risks but manage to preserve their investment when the bank or the banking system melt down. Basel III, with the abolition of Bail-Out, promotes burden sharing between all main stakeholders to shore up capitalisation when equity is needed to ensure both bank and the banking system's viability.

common equity bail-out E_G is used to maintain \underline{E}_C . The former kicks in if the common equity ratio is below τ , with E_P boosting the asset value to $\frac{F}{1-\underline{E}}$ and the total equity to $\frac{\underline{E}}{1-\underline{E}}F$ as before. Then $E_P = \frac{\underline{E}}{1-\underline{E}}F - (V_t - F) = \frac{1}{1-\underline{E}}F - V_t$. The latter kicks in if the common equity ratio even after the preference share injection is below the minimum common equity ratio \underline{E}_C , which occurs when $\frac{V_t - F}{1-\underline{E}} < \underline{E}_C \Leftrightarrow V_t < \frac{1-\underline{E}+\underline{E}_C}{1-\underline{E}}F$. Then the equityholders' values at $t < T$ are,

$$V_{E_E}^{BO} = \begin{cases} \frac{\max[V_t - F, 0]}{\frac{\underline{E}_C}{1-\underline{E}}F} C\left(\frac{F}{1-\underline{E}}, \frac{1-\underline{E}_C}{1-\underline{E}}F, r, \sigma, T - t\right) & \text{if } V_t < \frac{1-\underline{E}+\underline{E}_C}{1-\underline{E}}F \\ C\left(\frac{F}{1-\underline{E}}, \frac{2-\underline{E}}{1-\underline{E}}F - V_t, r, \sigma, T - t\right) & \text{if } \frac{1-\underline{E}+\underline{E}_C}{1-\underline{E}}F \leq V_t < \frac{F}{1-\tau} \\ C(V_t, F, r, \sigma, T - t) & \text{if } V_t \geq \frac{F}{1-\tau} \end{cases} \quad (5.33)$$

When there is no trigger ($V_t \geq \frac{F}{1-\tau}$), the equityholders' value is the same as under no bail-out/in. When there is just the preference shares injection ($\frac{1-\underline{E}+\underline{E}_C}{1-\underline{E}}F \leq V_t < \frac{F}{1-\tau}$), then the equityholders' position remains undiluted, but their claim at bond maturity T is now on the asset value V_T minus the sum of the bond face value F and the preference shares principal $\frac{F}{1-\underline{E}} - V_t$. The strike price of the call option is therefore $F + \frac{F}{1-\underline{E}} - V_t = \frac{2-\underline{E}}{1-\underline{E}}F - V_t$. Finally when there is also common equity injection ($V_t < \frac{1-\underline{E}+\underline{E}_C}{1-\underline{E}}F$), then the equityholders' share of equity is diluted to $\frac{\max[V_t - F, 0]}{\frac{\underline{E}_C}{1-\underline{E}}F}$, where $\frac{\underline{E}_C}{1-\underline{E}}F$ is the total common equity after bail-out. Their claim at T is on $V_T - F$ minus the maximum preference share injection of $\frac{\underline{E}-\underline{E}_C}{1-\underline{E}}F$, and therefore the strike price of the call option is $F + \frac{\underline{E}-\underline{E}_C}{1-\underline{E}}F = \frac{1-\underline{E}_C}{1-\underline{E}}F$.

Using preference shares instead of common shares in order to attain the minimum equity ratio \underline{E} has two opposing effects on the equityholders' position. The positive effect is that of no or less dilution. Specifically, compared to Eq.(5.31), in Eq.(5.33) we can see that

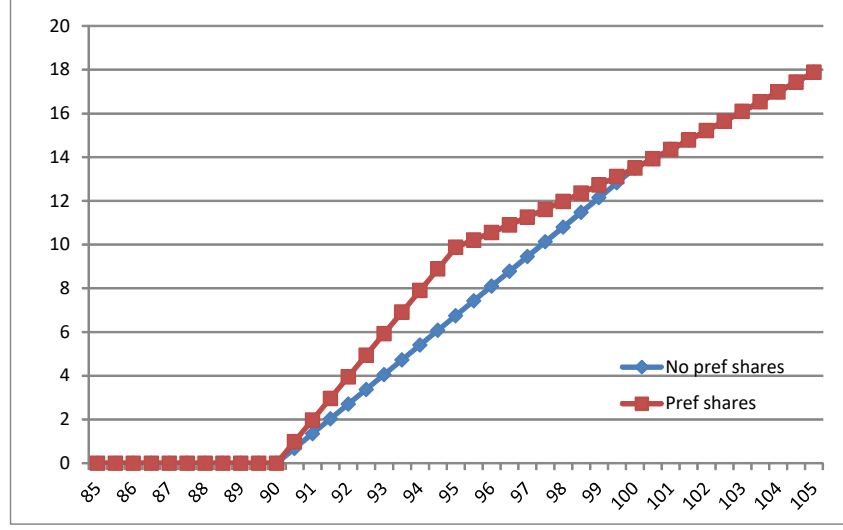


Figure 5.12: V_{EE}^{BO} with and without preference shares

when $\frac{1-\underline{E}+\underline{E}_C}{1-\underline{E}}F \leq V_t < \frac{F}{1-\tau}$ there is no dilution (only preference shares are injected), while when $V_t < \frac{1-\underline{E}+\underline{E}_C}{1-\underline{E}}F$, the dilution is smaller (there is less common equity injected). The negative effect is that of reduced claim on the asset due to higher ranking of the preference shares. This is reflected in the higher strike price of the call options in Eq.(5.33) (note, $\frac{2-\underline{E}}{1-\underline{E}}F - V_t > F$ for $V_t < \frac{F}{1-\underline{E}}$), which reduces the option value. Fig.5.12 shows that when $F = 90$, $\underline{E} = 10\%$, $\underline{E}_C = 5\%$, $r = 5\%$, $\sigma = 20\%$ and $T - t = 0.5$, the positive effect of smaller dilution outweighs the negative effect of smaller claim. Indeed, it can be shown that this is always the case:

Proposition 5.1 V_{EE}^{BO} is unambiguously larger with preference shares than without.

Proof. Note when $\underline{E}_C = \underline{E}$, the curves coincide in Fig.5.12. Therefore it suffices to show that the gap between the two curves at $V_t = \frac{1-\underline{E}+\underline{E}_C}{1-\underline{E}}F$ (the kink of the preference

shares curve) increases as \underline{E}_C decreases, or

$$\begin{aligned} & \frac{\partial}{\partial \underline{E}_C} \left[C \left(\frac{F}{1 - \underline{E}}, \frac{1 - \underline{E}_C}{1 - \underline{E}} F, r, \sigma, T - t \right) - \frac{\underline{E}_C}{\underline{E}} C \left(\frac{F}{1 - \underline{E}}, F, r, \sigma, T - t \right) \right] < 0 \\ \Leftrightarrow & \frac{F}{1 - \underline{E}} e^{-r(T-t)} N \left(d_2 \left(\frac{F}{1 - \underline{E}}, \frac{1 - \underline{E}_C}{1 - \underline{E}} F, r, \sigma, T - t \right) \right) < \frac{1}{\underline{E}} C \left(\frac{F}{1 - \underline{E}}, F, r, \sigma, T - t \right). \end{aligned} \quad (5.34)$$

But $N \left(d_2 \left(\frac{F}{1 - \underline{E}}, \frac{1 - \underline{E}_C}{1 - \underline{E}} F, r, \sigma, T - t \right) \right) < N \left(d_2 \left(\frac{F}{1 - \underline{E}}, F, r, \sigma, T - t \right) \right)$, and so it suffices to show that,

$$\begin{aligned} & \frac{\underline{E}}{1 - \underline{E}} F e^{-r(T-t)} N \left(d_2 \left(\frac{F}{1 - \underline{E}}, F, r, \sigma, T - t \right) \right) < C \left(\frac{F}{1 - \underline{E}}, F, r, \sigma, T - t \right) \\ \Leftrightarrow & \frac{\underline{E}}{1 - \underline{E}} F e^{-r(T-t)} N (d_2 (.)) < \frac{F}{1 - \underline{E}} N (d_1 (.)) - F e^{-r(T-t)} N (d_2 (.)) \quad (5.35) \\ \Leftrightarrow & e^{-r(T-t)} N (d_2 (.)) < N (d_1 (.)). \end{aligned}$$

This is true as $N (d_2 (.)) < N (d_1 (.))$, since $d_1 = d_2 + \sigma \sqrt{T - t}$. Therefore as \underline{E}_C decreases below \underline{E} , the equityholders are unambiguously better off with preference shares bail-out. ■

5.2 Wealth-Transfer Problem

Having established the details of the different bail-out / in structures, we now investigate the agency costs associated with the over-investment problems in these structures. We distinguish two types of such agency costs:

1. *Wealth-transfer problem.* This is when the equityholders have an incentive for higher risk-taking, normally represented by the vega of their option position.

2. *Value-destruction.* Eberhart and Senbet (1993) state, “Risk-shifting can enhance equity value even when higher risk projects are of lower value, implying that investment decisions can be distorted away from firm value maximisation.” When negative NPV projects are still beneficial to the equityholders (due to their convex payoff and the project’s higher volatility), the reduction in the firm’s total value represents this type of agency cost.

We investigate these in turn in this section and the next. For the purpose of the technical analyses, we assume $r > \frac{\sigma^2}{2}$ for the remainder of the chapter.

As common in the literature (e.g. Eberhart and Senbet, 1993; Berg and Kaserer, 2011), we investigate the vega of the equityholder position as a measure of their incentive to take on riskier projects. The vega for each of the above cases are,

$$\begin{aligned}
Vega_{EE}^N &= Vega_{EE}^{BO} = V_0 \sqrt{T} N' (d_1 (F)) \\
Vega_{EE}^{CN} &= Vega_{EE}^{CBO} = V_0 \sqrt{T} \left[(1 - \tau) N' \left(d_1 \left(\frac{F}{1 - \tau} \right) \right) - (1 - \tau) N' \left(d_1 \left(\frac{F_B}{1 - \tau} \right) \right) + N' (d_1 (F_B)) \right] \\
Vega_{EE}^{CBI} &= (1 - \tau) V_0 \sqrt{T} N' \left(d_1 \left(\frac{F}{1 - \tau} \right) \right) \\
Vega_{EE}^{WDBI} &= V_0 \sqrt{T} \left[(1 - \underline{E}) N' \left(d_1 \left(\frac{F}{1 - \tau} \right) \right) - (1 - \underline{E}) N' \left(d_1 \left(\frac{F_B}{1 - \underline{E}} \right) \right) + (1 - \tau) N' \left(d_1 \left(\frac{F_B}{1 - \tau} \right) \right) \right] \\
&\quad + \frac{1}{\sigma} d_1 \left(\frac{F}{1 - \tau} \right) (\underline{E} - \tau) \frac{F}{1 - \tau} e^{-rT} N' \left(d_2 \left(\frac{F}{1 - \tau} \right) \right) \\
Vega_{EE}^{WOBI} &= \frac{1}{\sigma} d_1 \left(\frac{F}{1 - \tau} \right) F_W e^{-rT} N' \left(d_2 \left(\frac{F}{1 - \tau} \right) \right) + (1 - \tau) V_0 \sqrt{T} N' \left(d_1 \left(\frac{F_B}{1 - \tau} \right) \right),
\end{aligned} \tag{5.36}$$

where $N' (d_1 (K)) = \frac{1}{\sqrt{2\pi}} e^{-\frac{[d_1(K)]^2}{2}}$ for strike price K . These are depicted in Fig.5.13. The graph compares the incentives for the equityholders to take on riskier projects at different values of V_0 above F between the five structures. We make the following observations:

Proposition 5.2 *With no bail-out/in or government bail-out, the incentive for higher risk*

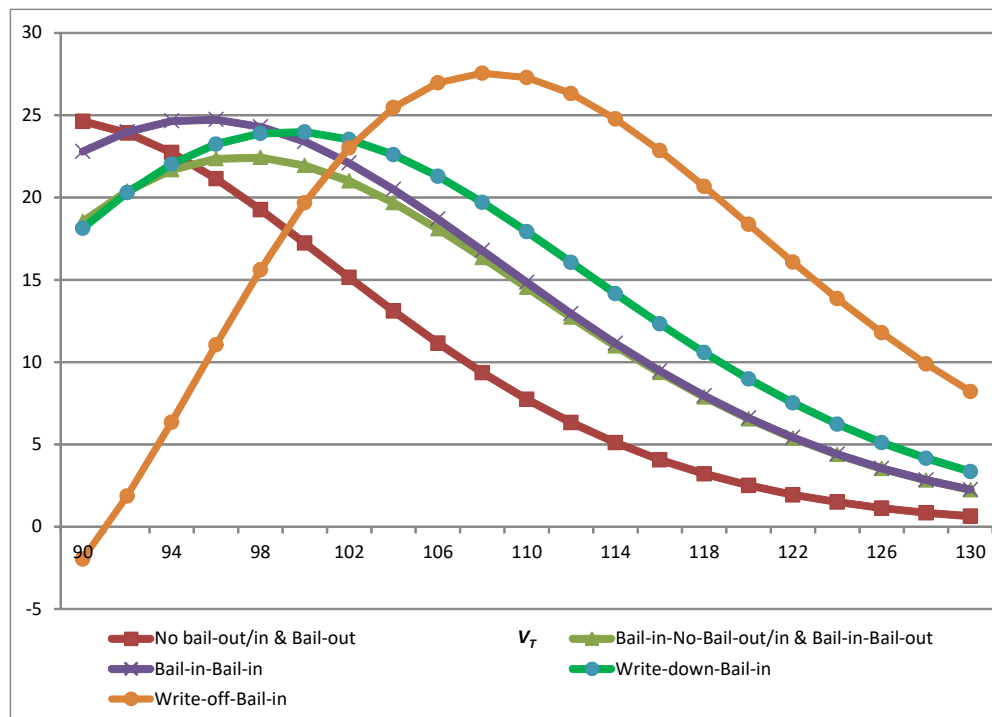


Figure 5.13: Vega vs V_0 when $F = 90$, $F_C = F_W = 20$, $\tau = 7\%$ and $\underline{E} = 10\%$

taking increases as the firm's asset value falls towards the critical value F .

In Fig.5.13 the critical value for no bail-out/in is $F = 90$. This basically states that the vega of a call option increases as the option approaches at-the-money (ATM). More technically,

Proof. The vega curve for no bail-out/in and government bail-out, $Vega_{EE}^N$ and $Vega_{EE}^{BO}$ in Eq.(5.36), is quasi-concave as e^{-x^2} is a quasi-concave function and $d_1(F)$ is a monotonically increasing function of V_0 . Its maximum occurs at,

$$\frac{\partial Vega_{EE}^N}{\partial V_0} = -\frac{1}{\sigma} d_2(F) N'(d_1(F)) = 0 \Leftrightarrow V_0 = F e^{-\left(r - \frac{\sigma^2}{2}\right)T}. \quad (5.37)$$

$\frac{\partial Vega}{\partial V_0}$, sometimes called the *vanna*, is therefore negative for $V_0 > F e^{-\left(r - \frac{\sigma^2}{2}\right)T}$, or $Vega_{EE}^N$ increases as V_0 falls towards F (and unambiguously so for $r > \frac{\sigma^2}{2}$). ■

The wealth-transfer happens when the equityholders choose higher σ projects, due to their positive vega values, which results in an increase in the value of their call option $C(F)$. In the no bail-out/in case there is an equal fall in the value of the bondholders' position, due to the rise in the value of their short put option position $P(F)$. Thus the wealth is transferred from the bondholders to the equityholders by the equityholders' actions. For the government bail-out case the wealth-transfer is from the government to the equityholders.

Proposition 5.3 *For the asset value above the trigger point, the risk-taking incentive is higher with equity-conversion CoCo bail-in than under no bail-out/in or the government bail-out.*

Proof. We show this for the case of bail-in-bail-in, which would be true if $Vega_{EE}^{CBI} > Vega_{EE}^{BO}$ for $V_0 > \frac{F}{1-\tau}$, or

$$(1-\tau) V_0 \sqrt{T} N' \left(d_1 \left(\frac{F}{1-\tau} \right) \right) > V_0 \sqrt{T} N' (d_1(F)) \text{ for } V_0 > \frac{F}{1-\tau}. \quad (5.38)$$

This is proved in Appendix 5.7.1. Note Fig.5.13 also depicts that this is true for the bail-in-no-bail-in/out and bail-in-bail-out cases, or $Vega_{EE}^{CN} = Vega_{EE}^{CBO} > Vega_{EE}^{BO}$ for $V_0 > \frac{F}{1-\tau} = 96.77$.¹⁸ ■

Proposition 5.4 *For higher asset values the risk-taking incentive is higher with the write-off CoCo bond than with the equity-conversion CoCo bond.*

Proof. For this we require $Vega_{EE}^{WOBI} > Vega_{EE}^{CBI}$ for sufficiently large V_0 . It suffices to show that $\frac{1}{\sigma} d_1 \left(\frac{F}{1-\tau} \right) F_W e^{-rT} N' \left(d_2 \left(\frac{F}{1-\tau} \right) \right) > (1-\tau) V_0 \sqrt{T} N' \left(d_1 \left(\frac{F}{1-\tau} \right) \right)$ for large V_0 . Note from the property of Black-Scholes option pricing model that $V_0 N' (d_1(K)) = K e^{-rT} N' (d_2(K))$ for strike price K . Then we require,

$$\begin{aligned} \frac{1}{\sigma} d_1 \left(\frac{F}{1-\tau} \right) \frac{F_W}{F} (1-\tau) V_0 N' \left(d_1 \left(\frac{F}{1-\tau} \right) \right) &> (1-\tau) V_0 \sqrt{T} N' \left(d_1 \left(\frac{F}{1-\tau} \right) \right) \\ \Leftrightarrow d_1 \left(\frac{F}{1-\tau} \right) &> \frac{F}{F_W} \sigma \sqrt{T} \\ \Leftrightarrow V_0 &> \frac{F}{1-\tau} e^{-\left[r - \left(\frac{F}{F_W} - \frac{1}{2} \right) \sigma^2 \right] T}. \end{aligned} \quad (5.39)$$

Thus $Vega_{EE}^{WOBI}$ is unambiguously larger than $Vega_{EE}^{CBI}$ for V_0 higher than $\frac{F}{1-\tau} e^{-\left[r - \left(\frac{F}{F_W} - \frac{1}{2} \right) \sigma^2 \right] T}$.

■

¹⁸Using Appendix 5.7.1 one can also prove that $Vega_{EE}^{CBI} > Vega_{EE}^{CN} = Vega_{EE}^{CBO}$ for $V_0 > \frac{F_B}{1-\tau}$.

For our numerical example, the expression on the right-hand side of Eq.(5.39) equals 102.25. The result of Proposition 5.4 can be checked in Fig.5.13. It is also clear in the diagram that $Vega_{EE}^{WOBI}$ is smaller than $Vega_{EE}^{CBI}$ for V_0 closer to the CoCo trigger point ($\frac{F}{1-\tau} = 96.77$); indeed the vega for write-off is lower even than for no bail-out/in case. This reflects the shape of the vega curve for the binary put option in Eq.(5.27), which takes a negative value when the option is deep in-the-money. This means that to the left of the trigger point of the write-off condor structure depicted in Fig.5.9, the vega of the option structure rapidly decreases, and takes a negative value when the holders of the write-off condor (the equityholders) benefit from lower volatility.

To conclude, using the detailed analysis of the bail-out/in structures outlined in Section 5.1, in this section we have been able to establish that, in comparison to the no bail-out/in or government bail-out cases, the equity-conversion CoCo bond exacerbates the wealth-transfer element of the agency cost for all firm values above the CoCo trigger point, and that the effect is even larger for the write-off CoCo bonds for larger values of V_0 . In option trading terms, this is analogous to the holder of an option having the right to determine the volatility of the underlying asset price. In financial markets, this would be an illegal manipulation.

5.3 Value Destruction

Value destruction agency cost occurs when the equityholders do not follow value maximisation for the firm. This is a principal-agent problem where the interest of the decision makers (the equityholders) does not align with that of the firm.

To investigate this, let there be a discrete set of projects defined by their expected outcome $E[V_T^i]$ and the return volatility σ^i . Let the market price of risk be λ . Then the present value of each project is,

$$V_0^i = e^{-r^i T} E[V_T^i] \text{ , where } r^i = r^f + \lambda \sigma^i \quad (5.40)$$

where r^i is the required rate of return of project i and r^f is the risk-free rate. Under value maximisation the firm would choose project m such that,

$$V_0^m = \max_i \{V_0^i\} . \quad (5.41)$$

On the other hand, under no bail-out the equityholders choose project m^N such that,

$$V_0^{m^N} = \max_i \{V_{E_E}^N(V_0^i)\} \text{ , where } V_{E_E}^N(V_0^i) = C(V_0^i, F, \sigma^i) \quad (5.42)$$

with $C(\cdot)$ as given in Eq.(5.3), where the arguments now specify the underlying asset value, the strike price and the volatility. When $m^N \neq m$, $V_0^{m^N} < V_0^m$, and hence there is value destruction.

The value destruction problem arises from the fact that the firm value is determined as the expected present value (Eq.(5.40)) and does not depend on the asset volatility beyond its effect on the required rate of return r^i , while for the equityholders their value increases with higher σ (positive vega of their call option position). Value destruction results when the reduction in the equityholders' value due to the lower choice of V_0^i (the delta effect), is more than offset by the increase in the value due to the higher volatility (the vega effect).

The degree of this effect can therefore be represented by the relative size of the two, which we denote η :

$$\eta = \frac{\Delta}{Vega}. \quad (5.43)$$

The smaller the η of the structure, the more likely that there will be value destruction.

The delta of the equityholders' positions for each bail-out/in structure are, respectively,

$$\begin{aligned} Delta_{EE}^N &= Delta_{EE}^{BO} = N(d_1(F)) \\ Delta_{EE}^{CN} &= Delta_{EE}^{CBO} = (1-\tau)N\left(d_1\left(\frac{F}{1-\tau}\right)\right) - (1-\tau)N\left(d_1\left(\frac{F_B}{1-\tau}\right)\right) + N(d_1(F_B)) \\ Delta_{EE}^{CBI} &= \tau + (1-\tau)N\left(d_1\left(\frac{F}{1-\tau}\right)\right) \\ Delta_{EE}^{WDBI} &= \tau - (\underline{E} - \tau)\frac{F}{1-\tau}\frac{e^{-rT}}{V_0\sigma\sqrt{T}}N'\left(-d_2\left(\frac{F}{1-\tau}\right)\right) + (1-\underline{E})N\left(d_1\left(\frac{F}{1-\tau}\right)\right) \\ &\quad - (1-\underline{E})N\left(d_1\left(\frac{F_B}{1-\underline{E}}\right)\right) + (1-\tau)N\left(d_1\left(\frac{F_B}{1-\tau}\right)\right) \\ Delta_{EE}^{WOBI} &= \tau - \frac{F_W e^{-rT}}{V_0\sigma\sqrt{T}}N'\left(-d_2\left(\frac{F}{1-\tau}\right)\right) + (1-\tau)N\left(d_1\left(\frac{F_B}{1-\tau}\right)\right). \end{aligned} \quad (5.44)$$

These are depicted on Fig.5.14.

We now make the following observations:

Proposition 5.5 *With no bail-out/in or government bail-out, the value destruction is more likely as the firm's asset value falls towards the critical value F .*

Proof. We already know from Eq.(5.44) that $Delta_{EE}^N = Delta_{EE}^{BO} = N(d_1(F))$.

Then,

$$\frac{\partial Delta_{EE}^N}{\partial V_0} = \frac{\partial Delta_{EE}^{BO}}{\partial V_0} = \frac{1}{V_0\sigma\sqrt{T}}N'(d_1(F)) > 0. \quad (5.45)$$

Therefore the deltas decrease as V_0 decreases. We also have established in Proposition 5.2

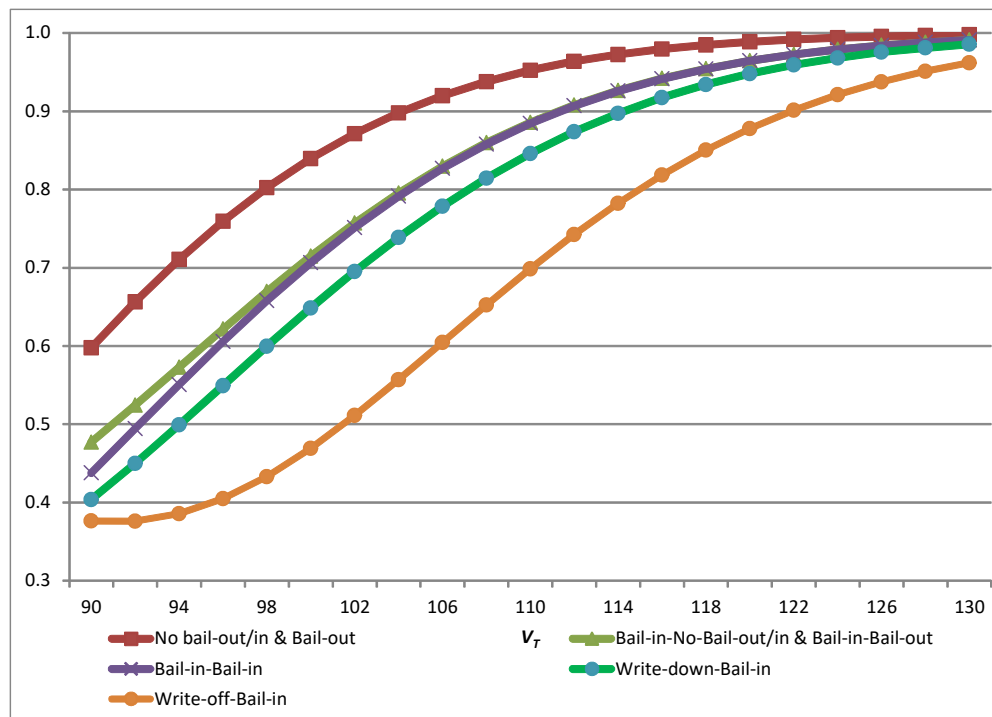


Figure 5.14: Delta vs V_0 when $F = 90$, $F_C = F_W = 20$, $\tau = 7\%$ and $\underline{E} = 10\%$

that $Vega_{EE}^N$ and $Vega_{EE}^{BO}$ increase as V_0 falls towards the critical value F . Therefore η is unambiguously decreasing for falling V_0 above F , indicating a higher likelihood of value destruction. ■

Proposition 5.6 *For the asset value above the trigger point, the value destruction is more likely with equity-conversion CoCo bail-in-bail-in than under no bail-out/in or the government bail-out.*

Proof. First we show that $Delta_{EE}^{CBI} < Delta_{EE}^{BO}$ for the required range of V_0 , or

$$\begin{aligned} N(d_1(F)) &< \tau + (1 - \tau) N\left(d_1\left(\frac{F}{1 - \tau}\right)\right) \\ \Leftrightarrow N(-d_1(F)) &< (1 - \tau) N\left(-d_1\left(\frac{F}{1 - \tau}\right)\right). \end{aligned} \quad (5.46)$$

To show this, consider the following derivative:

$$\begin{aligned} &\frac{\partial}{\partial V_0} \left[N(-d_1(F)) - (1 - \tau) N\left(-d_1\left(\frac{F}{1 - \tau}\right)\right) \right] \\ &= -\frac{1}{V_0 \sigma \sqrt{T}} \left[N'(-d_1(F)) - (1 - \tau) N'\left(-d_1\left(\frac{F}{1 - \tau}\right)\right) \right]. \end{aligned} \quad (5.47)$$

As $N'(-d_1(\cdot)) = N'(d_1(\cdot))$, we know from Eq.(5.38) that this is positive for $V_0 > \frac{F}{1 - \tau}$.

Also,

$$\lim_{V_0 \rightarrow \infty} \left[N(-d_1(F)) - (1 - \tau) N\left(-d_1\left(\frac{F}{1 - \tau}\right)\right) \right] = 0 \quad (5.48)$$

as the limit for both terms are zero. This means that $N(-d_1(F)) - (1 - \tau) N\left(-d_1\left(\frac{F}{1 - \tau}\right)\right)$ approaches 0 from below as V_0 increases from $\frac{F}{1 - \tau}$, proving that $Delta_{EE}^{CBI} < Delta_{EE}^{BO}$ for $V_0 > \frac{F}{1 - \tau}$. We also know from Proposition 5.3 that $Vega_{EE}^{CBI} > Vega_{EE}^{BO}$ for $V_0 > \frac{F}{1 - \tau}$.

Together this implies that η is unambiguously lower for equity-conversion bail-in-bail-in than for no bail-out/in or government bail-out. This indicates a higher likelihood of value destruction for the former. ■

Figs.5.13 and 5.14 suggest that this is also true for the remaining equity-conversion CoCo bail-in cases, namely the bail-in-no-bail-out/in and the bail-in-bail-out.

Proposition 5.7 *For higher asset values the value destruction is more likely with the write-off CoCo bond than with the equity-conversion bail-in-bail-in case.*

Proof. Again compare the deltas. $\Delta_{E_E}^{WOBI} < \Delta_{E_E}^{CBI}$ if,

$$-\frac{F_W e^{-rT}}{V_0 \sigma \sqrt{T}} N' \left(-d_2 \left(\frac{F}{1-\tau} \right) \right) + (1-\tau) N \left(d_1 \left(\frac{F_B}{1-\tau} \right) \right) - (1-\tau) N \left(d_1 \left(\frac{F}{1-\tau} \right) \right) < 0. \quad (5.49)$$

Appendix 5.7.2 proves that this is true for $V_0 > \frac{F}{1-\tau}$. We already know from Proposition 5.4 that $Vega_{E_E}^{WOBI} > Vega_{E_E}^{CBI}$ for sufficiently large V_0 . Together this implies that η is lower for the write-off-bail-in for sufficiently large V_0 than for the equity-conversion bail-in-bail-in, indicating a higher likelihood of value destruction. ■

Figs.5.13 and 5.14 suggest that this is also true for the write-down-bail-in case.

To conclude, not only do introduction of equity-conversion or write-down/off CoCo bonds increase the incentive for wealth-transfer by increasing the vega of the equityholders' position, as shown in Section 5.2, in this section we have established that it also increases the incentive for value destruction by decreasing the delta, hence aggravating the delta-vega ratio η . Closer to the trigger point, this suggests a higher temptation to attempt “gamble-

for-resurrection”, where the equityholders sacrifice firm value for high risk strategies, in the hope for a positive outcome.

5.4 CoCo Bond as Non-admissible Debt-to-Equity Swap

In the above sections we concluded that the equity-conversion CoCo and write-down/off bond bail-in structures have inherently higher agency costs than under no bail-out/in. However, in reality banks are rarely allowed to become insolvent, with restructuring occurring long before the asset value is allowed to fall below F . Here we consider one of those possibilities, the debt-to-equity swap (DES), and compare this with the CoCo bail-in structure.

We begin with a detailed investigation of the DES structure. The framework is an extension of Moraux and Navatte (2009) (MN here onwards). As before a firm is financed by equity and a zero coupon bond with maturity T and face value F . Under normal APR the payoffs at T for the debt and equityholders are similar to Eq.(5.2), with an additional feature of bankruptcy costs of a proportion $1 - \beta \in (0, 1]$ of the asset value V_T . Then according to MN, the bondholders’ payoff when there is no DES is,

$$D_B^N = \begin{cases} F, & \text{if } V_T \geq F \\ \beta V_T, & \text{if } V_T < F \end{cases}. \quad (5.50)$$

The existence of the bankruptcy cost means that there is a gain from restructuring, which the stakeholders can share. In a DES the bondholders rescue the equityholders by: (i) extending the existing debt by further s years to $S = T + s$ at rate r , and (ii) forgiving an

amount $A \in [0, F]$ of the debt while receiving a proportion $\theta \in [0, 1]$ of the firm's equity in exchange. As extreme examples, $\theta = 0$ with $A > 0$ means that the bondholders forgive part or all of the debt with no equity in return, while $\theta = 1$ means that they expropriate current equityholders. As with MN we assume that bondholders control the financial restructuring but with no intent to take over the firm, i.e. $\theta < 1$. In contrast to MN, which assumes that the DES only kicks in when $V_T < F$, we assume that DES is enforced by the regulator at the point of non-viability (PONV), which reflects the reality more. This level is further assumed to be the same as the bail-out/in trigger point τ in previous sections. Hence DES is implemented when $V_T \leq \frac{F}{1-\tau}$. Post-DES, at the new bond maturity S the face value of the debt is $(F - A)e^{rs}$.¹⁹ For $V_T > \frac{F}{1-\tau}$ when there is no DES, the debt is assumed to roll over to S with the new face value Fe^{rS} . For simplicity, we assume there to be no debt restructuring at S irrespective of the asset value V_S .²⁰ The table below summarises the stakeholders' holdings at S for different scenarios:

V_T range at T	Solvent at S	Insolvent at S
No DES at T $\left(\frac{F}{1-\tau}, \infty\right]$	$V_S \geq Fe^{rs}$ $D_S = Fe^{rs}$ $E_S = V_S - Fe^{rs}$	$V_S < Fe^{rs}$ $D_S = \beta V_S$ $E_S = 0$
DES at T $\left[0, \frac{F}{1-\tau}\right]$	$V_S \geq (F - A)e^{rs}$ $D_S = (F - A)e^{rs} + \theta[V_S - (F - A)e^{rs}]$ $E_S = (1 - \theta)[V_S - (F - A)e^{rs}]$	$V_S < (F - A)e^{rs}$ $D_S = \beta V_S$ $E_S = 0$

¹⁹This differs from MN, who seem to assume that the repayment for the remaining debt $F - A$ is simply postponed until S with zero interest cost. The problem with this assumption is that, *ceteris paribus*, the debtholders would always want an immediate redemption.

²⁰This can be an extension to this analysis. Especially in the case that $V_T \geq \frac{F}{1-\tau}$ at T , it seems reasonable to allow DES at S when $V_S < \frac{Fe^{rs}}{1-\tau}$, even if we rule out repeated restructuring for the case of $V_T < \frac{F}{1-\tau}$ and $V_S < \frac{(F-A)e^{rs}}{1-\tau}$.

(5.51)

The expected present value at time T of the stakeholders' payoffs at time S can now be calculated. When there is no DES at T , these are,

$$\begin{aligned}
 V_{B_T}^{NoDES} &= e^{-rs} \widehat{E}_T [F e^{rs} \chi_{V_S \geq F e^{rs}} + \beta V_S \chi_{V_S < F e^{rs}}] \\
 &= \beta V_T N(-d_1(F e^{rs})) + F N(d_2(F e^{rs})) \\
 V_{E_T}^{NoDES} &= e^{-rs} \widehat{E}_T [(V_S - F e^{rs}) \chi_{V_S \geq F e^{rs}}] \\
 &= V_T N(d_1(F e^{rs})) - F N(d_2(F e^{rs})),
 \end{aligned} \tag{5.52}$$

where $\widehat{E}_T[\cdot]$ is the risk-neutral expectation taken at time T and χ is again an indicator function. Similarly when DES is triggered,

$$\begin{aligned}
 V_{B_T}^{DES} &= e^{-rs} \widehat{E}_T [\{(F - A) e^{rs} + \theta [V_S - (F - A) e^{rs}]\} \chi_{V_S \geq (F - A) e^{rs}} + \beta V_S \chi_{V_S < (F - A) e^{rs}}] \\
 &= \beta V_T + (\theta - \beta) V_T N(d_1((F - A) e^{rs})) + (1 - \theta) (F - A) N(d_2((F - A) e^{rs})) \\
 V_{E_T}^{DES} &= e^{-rs} \widehat{E}_T [(1 - \theta) [V_S - (F - A) e^{rs}] \chi_{V_S \geq (F - A) e^{rs}}] \\
 &= (1 - \theta) [V_T N(d_1((F - A) e^{rs})) - (F - A) N(d_2((F - A) e^{rs}))].
 \end{aligned} \tag{5.53}$$

Note as a special case, when $s \rightarrow \infty$, $V_{B_T}^{DES} = \beta V_T + (\theta - \beta) V_T$, i.e. for a very long term investment the creditors are incited to swap debt for equity only when $\theta > \beta$.

The restructuring problem is a choice of three parameters: the amount of debt forgiven, A , the proportion of equity received, θ , and the term to maturity of the rescheduled bond, s . With the bondholders controlling the financial restructuring, their problem is that

of maximising their wealth with the choice of (A, θ, s) . The equityholders are always better off with the DES for $\theta < 1$, as they will receive a strictly positive claim instead of the zero value that would result from bankruptcy.

First consider the socially optimal outcome when DES is triggered (i.e. $V_T < \frac{F}{1-\tau}$).

This is where the total present value of the firm is maximised:

$$\max_{A,s} e^{-rs} \widehat{E}_T[V_S] = \beta V_T + (1 - \beta) V_T N(d_1((F - A)e^{-rs})). \quad (5.54)$$

When there is no DES, then the firm is dissolved, losing bankruptcy costs. This is the first term βV_T . The second term is the net gain of restructuring of not incurring the bankruptcy costs, which happens with the probability $N(d_1((F - A)e^{-rs}))$. In DES this gain is shared between the stakeholders. Eq.(5.54) is monotonically increasing in A for any given s , and thus the first-best is attained at $A^* = F$. This is intuitive: a strictly positive value of $F - A$ implies a strictly positive probability of insolvency at the new maturity S ; given the non-zero bankruptcy costs $1 - \beta$, this reduces the present value of the firm. Hence the firm value is maximised at $A = F$ where the future insolvency probability is zero. Now comparing Eq.(5.54) with $V_{B_T}^{DES}$ in Eq.(5.53) reveals that the socially optimal outcome can be implemented by the choice $\theta^* = 1$. This is again intuitive; setting $\theta^* = 1$ aligns the interests of the decision-maker (in the case of a DES, the bondholders) with that of the total firm. Thus any equilibrium outcome with $\theta^* \in (0, 1)$ would be second-best. However,

Proposition 5.8 *When the bondholders have the full bargaining power, their optimal strategy is the full takeover of the firm, $(A, \theta) = (F, 1)$.*

Proof. Consider the following derivatives of $V_{B_T}^{DES}$:

$$\begin{aligned}\frac{\partial V_{B_T}^{DES}}{\partial \theta} &= V_T N(d_1((F - A)e^{rs})) - (F - A) N(d_2((F - A)e^{rs})) > 0 \quad \forall \theta \quad \forall A \\ \frac{\partial V_{B_T}^{DES}}{\partial A} &= \frac{(1-\beta)}{\sigma\sqrt{s}} N'(d_2((F - A)e^{rs})) - (1 - \theta) N(d_2((F - A)e^{rs})).\end{aligned}\tag{5.55}$$

The monotonicity of $\frac{\partial V_{B_T}^{DES}}{\partial \theta}$ is not surprising; whilst A determines the future default probability, and hence the present value of the firm, θ simply determines the stakeholders' shares of it. Therefore for any levels of A the bondholders would prefer the full transfer $\theta^*(A) = 1$.²¹ The second derivative in Eq.(5.55) suggests that there are two opposing effects of an increase in A on the value of $V_{B_T}^{DES}$: an increase in A increases the total value of the firm by decreasing the probability of future default, but it also decreases the face value of the bond holding. Now suppose that the optimal outcome is (A^*, θ^*) with $A^* < F$ and $\theta^* < 1$. However this outcome is not stable, as we know that $\theta^*(A) = 1 \quad \forall A$. At $\theta = 1$, $\frac{\partial V_{B_T}^{DES}}{\partial A} > 0$ unambiguously, and the bondholders will optimally choose $A = F$ where $V_{B_T}^{DES} = V_T$. This is the only stable outcome. ■

The above result basically states that the bondholders are happy to forgive all of their bond holdings (which also removes totally the possibility of future insolvency), if they can gain the full stake in the firm. Note then the choice of s is irrelevant. This is also the socially optimal outcome discussed above. The result can also be demonstrated diagrammatically by the use of indifference curves (ICs). Consider the following derivatives

²¹Similarly, $\frac{\partial V_{E_T}^{DES}}{\partial \theta} < 0 \quad \forall \theta \quad \forall A$ implies that the equityholders would always prefer $\theta^*(A) = 0$.

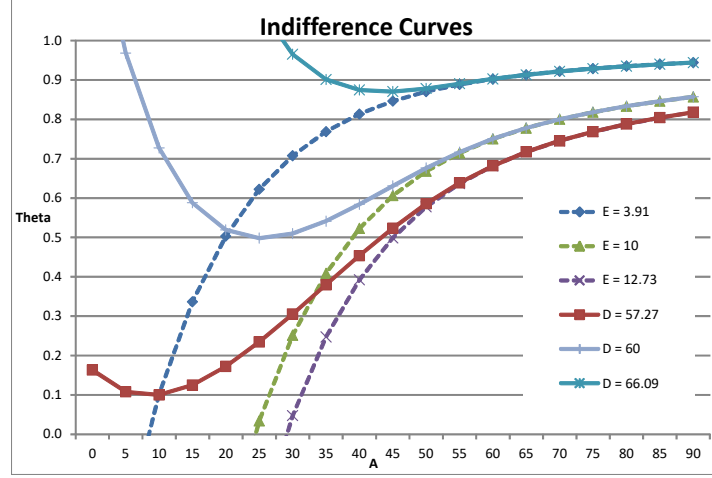


Figure 5.15: Indifference Curves for Equityholders and Bondholders: $V_T = 70$, $F = 90$, $r = 6\%$, $\sigma = 20\%$, $s = 2$ and $\beta = 0.8$

of $V_{E_T}^{DES}$:

$$\begin{aligned} \frac{\partial V_{E_T}^{DES}}{\partial \theta} &= -[V_T N(d_1((F - A)e^{rs})) - (F - A)N(d_2((F - A)e^{rs}))] < 0 \quad \forall \theta \quad \forall A \\ \frac{\partial V_{E_T}^{DES}}{\partial A} &= (1 - \theta)N(d_2((F - A)e^{rs})) > 0 \quad \forall \theta \quad \forall A. \end{aligned} \quad (5.56)$$

Thus for equityholders there is a simple trade-off between A and θ . Their ICs, drawn on a $\theta - A$ plane, will therefore be upward-sloping. The ICs of the bondholders are downward-sloping for lower values of A where $\frac{\partial V_{B_T}^{DES}}{\partial A} > 0$, while they turn upward-sloping for larger values of A when $\frac{\partial V_{B_T}^{DES}}{\partial A} < 0$. Examples of these ICs are depicted in Fig.5.15, where the solid curves are the bondholders' ICs and the dashed curves are those of the equityholders. The equityholders are better off with lower ICs, while the bondholders are better off with higher ICs. The turning point in the bondholders' ICs is where they can attain the highest IC given the value of θ , i.e. where the value of their holding is maximised for that level

of θ .²² In all cases the tangency points of the ICs are shown to be at $A = 90$, i.e. at $A = F$. There is a continuum of such Pareto efficient equilibria, and the choice of the final outcome depends on the relative bargaining power of the stakeholders. With full bargaining power the bondholders optimise at $V_{B_T}^{DES} = V_T$, attained by the choices $(A^*, \theta^*) = (F, 1)$, as derived in Proposition 5.8. On the other hand if the equityholders had the full bargaining power, it would result in $V_{B_T}^{DES}$ being driven down to the bondholders' outside option, which is default without DES when they would receive βV_T . Note that this minimum value for the bondholders ensures that $\theta^* \geq \beta$ for all cases of DES.

In reality, however, we observe partial forgiveness $A < F$. In order to achieve this we introduce a cost term $C(\theta)$ for the bondholders of higher control of the firm, with $C' > 0$, $C'' > 0$, $C(0) = 0$ and $\lim_{\theta \rightarrow 1} C(\theta) = \infty$. This reflects the bondholders' reluctance to take over the firm. This may be because they lack the company and industry expertise and the know-how of shareholders, or that their mandate to invest in low yielding, low volatile instruments may mean that they would be forced to sell equity position. For our analysis here we let $C(\theta) = \frac{k\theta}{1-\theta}$ for some constant $k > 0$. We will see below that the inclusion of the cost term results in the bondholders choosing an outcome that is less than the socially optimal. The bondholders' value under DES is now,

$$V_{B_T}^{DES} = \beta V_T + (\theta - \beta) V_T N(d_1((F - A)e^{rs})) + (1 - \theta)(F - A) N(d_2((F - A)e^{rs})) - \frac{k\theta}{1 - \theta}. \quad (5.57)$$

Now we define the admissibility of a DES under full bondholder bargaining power

²²For example for $\theta = 0.1$, the maximum value for the bondholders is that of the IC tangent to the horizontal line $\theta = 0.1$. On the diagram this is shown to be $V_{B_T}^{DES} = 57.27$.

as follows:²³

Definition 1 (DES Admissibility) *A DES structure is **admissible** if the parameters (A^*, θ^*, s^*) maximise the value of bondholders' holdings:*

$$(A^*, \theta^*, s^*) = \arg \max_{A, \theta, s} V_{B_T}^{DES} \text{ subject to } V_{B_T}^{DES} \geq \beta V_T \quad (5.59)$$

where $A \in [0, F]$, $\theta \in [0, 1]$ and $s \geq 0$, and $V_{B_T}^{DES}$ is given by Eq.(5.57).

This problem can be solved in two stages: first, find the optimal (A^*, θ^*) given s , and second, find s^* with the maximum $V_{B_T}^{DES}$. In focussing on the first stage, the first-order conditions are:

$$\begin{aligned} \frac{\partial V_{B_T}^{DES}}{\partial \theta} &= V_T N(d_1((F-A)e^{rs})) - (F-A)N(d_2((F-A)e^{rs})) - \frac{k}{(1-\theta)^2} = 0 \\ \frac{\partial V_{B_T}^{DES}}{\partial A} &= \frac{(1-\beta)}{\sigma\sqrt{s}} N'(d_2((F-A)e^{rs})) - (1-\theta)N(d_2((F-A)e^{rs})) = 0. \end{aligned} \quad (5.60)$$

²³In their definition of admissibility, MN has the condition that the received portion of equity exactly covers the amount of the face value of the debt forgiven,

$$\begin{aligned} A &= e^{-rs} \widehat{E}_T \left[\theta [V_S - (F-A)e^{rs}] \chi_{V_S \geq (F-A)e^{rs}} \right] \\ &= \theta [V_T N(d_1((F-A)e^{rs})) - (F-A)N(d_2((F-A)e^{rs}))]. \end{aligned} \quad (5.58)$$

Denote Eq.(5.58) by $f(A, s)$. They argue that this condition may be viewed as an equilibrium condition: for bondholders, the amount A forgiven is the maximum for a given portion θ of equity received, while for equityholders, it is the minimum amount acceptable. We believe that this is not the case. In their Table 1 they simulate the optimal (A^*, s^*) for $\theta = 0.5$ and different values of β and V_T . Then for $\beta = 0.8$ and $V_T = 30$, their admissible (A^*, s^*) are computed as (1.25, 2.48). In this case $f(1.25, 2.48) = 1.25$, i.e. the PV of the equity received (in their set-up - see footnote 19) equals the forgiven amount, as assumed. Then $V_{B_T}^{DES} = 24.07 + 1.25 = 25.32$, where 24.07 is the PV of the restructured bond. However for $A = 7.04$, it can be computed that $f(7.04, 2.48) = 2.25$ and $V_{B_T}^{DES} = 23.27 + 2.25 = 25.52$. In other words, the bondholders are able to increase their value by forgiving A *higher than* the PV of the equity received. The equityholders are also better off as $V_{B_T}^{DES}$ increases from 1.25 to 2.25, and this is therefore a Pareto-improving agreement. As such, MN's admissibility condition does not yield a Pareto efficient outcome. Intuitively, by increasing A the bondholders are able to increase the value of their equity holding *more* than the loss in the value of the remaining debt.

Solving the simultaneous equations yields the optimal A^* as the solution to,

$$V_T N(d_1((F-A)e^{rs})) - (F-A) N(d_2((F-A)e^{rs})) - \frac{k\sigma^2 s}{(1-\beta)^2} \left[\frac{N(d_2((F-A)e^{rs}))}{N'(d_2((F-A)e^{rs}))} \right]^2 = 0 \quad (5.61)$$

and θ^* given by,

$$\theta^* = 1 - \frac{(1-\beta) N(d_2((F-A)e^{rs}))}{\sigma\sqrt{s} N'(d_2((F-A)e^{rs}))}. \quad (5.62)$$

Then:

1. $A^* < F$, as $A = F$ cannot be the solution for Eq.(5.61) as then the last term goes to ∞ .
2. $\theta^* < 1$.

Compare now this DES scheme with the equity-conversion CoCo bail-in-bail-in structure. For the latter, the CoCo bail-in kicks in at time T as described in earlier sections. Unlike the earlier sections we introduce future default risk at time $S > T$. For simplicity we assume that when the CoCo bonds are partially (but not wholly) converted at their maturity T , then the remaining matured CoCo bonds are replaced by vanilla bonds of the same face value. This means that there will be no CoCo bail-in at time S . Then the payoffs at S are,

V_T range at T	Solvent at S	Insolvent at S
No CoCo trigger $\left(\frac{F}{1-\tau}, \infty\right]$	$V_S \geq F e^{rs}$ $D_S = F e^{rs}$ $E_S = V_S - F e^{rs}$	$V_S < F e^{rs}$ $D_S = \beta V_S$ $E_S = 0$
Partial CoCo trigger $\left(\frac{F_B}{1-\underline{E}}, \frac{F}{1-\tau}\right]$	$V_S \geq (1 - \underline{E}) V_T e^{rs}$ $D_S = (1 - \underline{E}) V_T e^{rs} + \frac{\underline{E}-\tau}{\underline{E}} [V_S - (1 - \underline{E}) V_T e^{rs}]$ $E_S = \frac{\tau}{\underline{E}} [V_S - (1 - \underline{E}) V_T e^{rs}]$	$V_S < (1 - \underline{E}) V_T e^{rs}$ $D_S = \beta V_S$ $E_S = 0$
Full CoCo trigger $\left[\frac{F_B}{1-\tau}, \frac{F_B}{1-\underline{E}}\right]$	$V_S \geq F_B e^{rs}$ $D_S = F_B e^{rs} + \frac{(1-\tau)V_T - F_B}{V_T - F_B} (V_S - F_B e^{rs})$ $E_S = \frac{\tau V_T}{V_T - F_B} (V_S - F_B e^{rs})$	$V_S < F_B e^{rs}$ $D_S = \beta V_S$ $E_S = 0$
Forced bail-in by vanilla bondholders $\left[0, \frac{F_B}{1-\tau}\right)$	$V_S \geq (1 - \underline{E}) V_T e^{rs}$ $D_S = (1 - \underline{E}) V_T e^{rs} + \frac{\underline{E}-\tau}{\underline{E}} [V_S - (1 - \underline{E}) V_T e^{rs}]$ $E_S = \frac{\tau}{\underline{E}} [V_S - (1 - \underline{E}) V_T e^{rs}]$	$V_S < (1 - \underline{E}) V_T e^{rs}$ $D_S = \beta V_S$ $E_S = 0$

(5.63)

For example, as established in Section 5.1, when $V_T \in \left(\frac{F_B}{1-\underline{E}}, \frac{F}{1-\tau}\right]$ the CoCo bondholders end up with $D_C = (1 - \underline{E}) V_T - F_B$ of the unconverted (and now matured) bond and $E_C = (\underline{E} - \tau) V_T$ of equity. Therefore in aggregate the bondholders' (the original vanilla bondholders and the CoCo bondholders) position is $F_B + [(1 - \underline{E}) V_T - F_B] = (1 - \underline{E}) V_T$ of vanilla bond and $(\underline{E} - \tau) V_T$ of equity. At S the firm will remain solvent if $V_S \geq (1 - \underline{E}) V_T e^{rs}$, in which case the bondholders' position is the total of $(1 - \underline{E}) V_T e^{rs}$ of bond and a share $\frac{\underline{E}-\tau}{\underline{E}}$ of the equity $V_S - (1 - \underline{E}) V_T e^{rs}$.

Then,

Proposition 5.9 *CoCo bond bail-in is a non-admissible DES.*

Proof. Compare the CoCo payoffs for the bondholders in Table (5.1) with those of DES in Table (5.1). The two are equivalent when $V_T \geq \frac{F}{1-\tau}$ (no DES, no bail-in). When $V_T \in \left(\frac{F_B}{1-\underline{E}}, \frac{F}{1-\tau}\right]$ and $V_T \in \left[0, \frac{F_B}{1-\tau}\right)$, the DES payoff is equivalent to the CoCo payoff

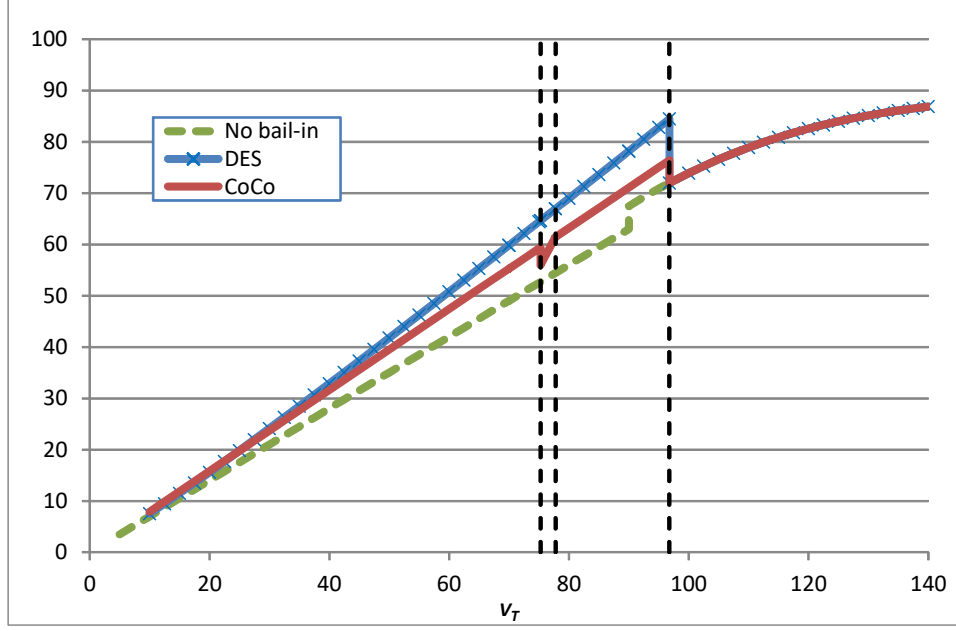


Figure 5.16: PV at T for Bondholders: $F = 90$, $F_C = 20$, $r = 6\%$, $\sigma = 20\%$, $s = 2$ years, $\beta = 0.7$, $k = 1$, $\tau = 7\%$ and $\underline{E} = 10\%$

when $A = F - (1 - \underline{E}) V_T$ and $\theta = \frac{\underline{E} - \tau}{\underline{E}}$. Similarly when $V_T \in \left[\frac{F_B}{1 - \tau}, \frac{F_B}{1 - \underline{E}} \right]$, the two are equivalent when $A = F_C$ and $\theta = \frac{(1 - \tau)V_T - F_B}{V_T - F_B}$. This means that the CoCo outcome is within the (unconstrained) feasible set of possible DESs, but they do not satisfy the first-order conditions (5.61) and (5.62). Hence the CoCo outcome cannot be the admissible DES.

■

Basically, in contrast to the DES, in equity-conversion CoCo bail-in the bondholders are unable to negotiate A or θ to achieve their optimal debt-to-equity conversion as these parameters are pre-defined at the CoCo bond inception. Indeed the write-off bond is the worst case scenario where A and θ are pre-set at $(F, 0)$.

Fig.5.16 graphs the present values (PV) at T of the bondholders' payoffs for both

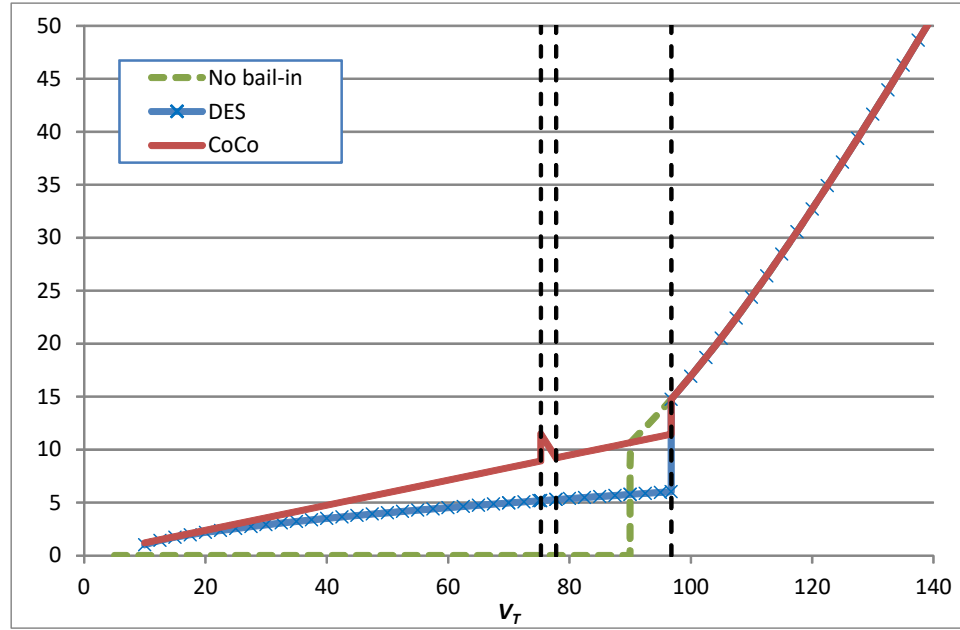


Figure 5.17: Extra Gain to Equityholders Resulting From Equity Conversion of CoCos: PV at T for Equityholders: $F = 90$, $F_C = 20$, $r = 6\%$, $\sigma = 20\%$, $s = 2$ years, $\beta = 0.7$, $k = 1$, $\tau = 7\%$ and $\underline{E} = 10\%$

admissible DES and CoCo structures. The regions divided by vertical lines correspond to those specified in Table (5.1). The admissible DES PV is simulated by solving Eq.(5.61) numerically for the optimal A^* for each V_T , which is then substituted in Eq.(5.62) to compute θ^* . As shown, the bondholders are able to attain higher values by their choice of A and θ than under the CoCo structure.

Fig.5.17 graphs the PV at T of the equityholders' payoffs for both admissible DES and CoCo structures. For them their PV is higher under CoCo than under DES. The graph suggests that if the equityholders knew for certain that a DES would be implemented, then under DES too they would have an incentive to take higher risks and sacrifice firm value than would be under no bail-in case. However as shown, these agency costs are still higher

under CoCo bail-in than for the traditional DES.

5.5 Optimal Volatility: Risk Return Trade Off for Equity-holders Under Basel III

In section 5.2 we have argued that higher vega means higher agency costs. However it does not state "how much higher". If we can, then perhaps we could suggest a practical solution for controlling the risk taking behaviour from shareholders. This is what we aim in this section.

Consider a bank that raises fund by equity and debt. The fund is invested in a portfolio of projects, whose outcomes are uncertain. Then for risk-averse investors, the present value of the bank's asset value is estimated using an appropriate risk-adjusted discount rate. The optimal portfolio decision is then dependent on the risk-return profiles of the feasible project mixes. In particular there may be a trade-off between higher risk-taking, which is assumed to lead to a possible higher expected outcome at maturity, and higher discounted rate. There is nothing in the literature to suggest how the bank selects its optimal portfolio within such a scenario.

Here we build a model of a simple bank with two possible investment projects with uncertain outcomes. Assuming sufficiently low correlation between the two outcomes, there is a risk-diversification effect in choosing a portfolio of the two projects. This results in a higher present value of the portfolio due to a lower risk-adjusted rate required for discounting. Under a simple condition then there exists an interior solution to the bank's maximum value, which is the bank's first-best choice of portfolio. However the decision of

portfolio selection is taken by the equityholders, whose convex payoff structure (they gain fully from the bank's success, however their loss is limited) means that their optimization behaviour of the value of their holdings would lead to a sub-optimal choice of portfolio selection. This can be analysed somewhat using an indifference curve model, similar to that adopted by Jensen and Meckling (1976) in their analysis of monitoring of the behaviour of the managers with non-pecuniary benefits. The indifference curves describe the trade-off between risk (volatility) and value, as described above, and are therefore downward-sloping. The curves are moreover quasi-concave in shape: it is concave when the value of the bank is high, while it becomes convex as the solvency drops towards the Point of Non Viability (PONV), particularly when a Bail-out or a Bail-in would put a floor to the value of the equityholders' position. The equityholders' choice of portfolio is given by the tangent point between the bank's possible project portfolio frontier and their highest attainable indifference curve. The choice of the second-best portfolio results in a lower present value of the bank's asset value, as well as a transfer of value from the bondholders to the equityholders due to higher risk taken. These again represent the two types of agency costs already discussed (value destruction and wealth transfer). We analyse these under different restructuring scenarios of expropriation (i.e. no Bail-out or Bail-in), Government Bail-out with preference / ordinary shares, Bail-in with equity-conversion CoCo bonds and Bail-in with write-off CoCo bonds.

The set-up differs from the traditional models in two ways. Firstly, it assumes the distribution of possible future outcomes of projects to be given, which is then discounted to today to estimate the present values. Thus, the choice of projects affects the present value,

not only through the chosen expected future value, but also via its effect on the required discount rate. This differs from the Merton (1974) set-up, where the future values of a security is given as a distribution of outcomes given today's value of the security.²⁴ Secondly the model contrasts with the CAPM set-up where the securities are priced assuming that all of idiosyncratic risk have been diversified away, which cannot be assumed for the limited number of possible projects available to a bank.

5.5.1 Bank's Project Plans

The bank has two possible projects, $i = 1, 2$, both of which mature at T . Their expected value and variance are given by $E[V_T^i]$ and σ_i^2 , with correlation ρ . A "project plan" is given by the weights $(w, 1 - w)$ of the two projects, and has the expected value and the variance,

$$\begin{aligned} E[V_T(w)] &= wE[V_T^1] + (1 - w)E[V_T^2] \\ \sigma^2(w) &= w^2\sigma_1^2 + (1 - w)^2\sigma_2^2 + 2w(1 - w)\rho\sigma_1\sigma_2. \end{aligned} \tag{5.64}$$

Assume project 1 is riskier than project 2, i.e. $E[V_T^1] > E[V_T^2]$ and $\sigma_1 > \sigma_2$. Then in minimizing $\sigma^2(w)$ with respect to $w \in (0, 1)$, for low sufficient ρ , namely $\rho \in \left[-1, \frac{\sigma_2}{\sigma_1}\right)$,

²⁴Jensen and Meckling (1976) make the same point when they state, "While we used the option pricing model above to motivate the discussion and provide some intuitive understanding of the incentives facing the equity holders, the option pricing solutions of Black and Scholes (1973) do not apply when incentive effects cause V to be a function of the debt/equity ratio as it is in general and in this example. Long (1974) points out this difficulty with respect to the usefulness of the model in the context of tax subsidies on interest and bankruptcy cost. The results of Merton (1974) and Galai and Masulis (1976) must be interpreted with care since the solutions are strictly incorrect in the context of tax subsidies and/or agency costs".

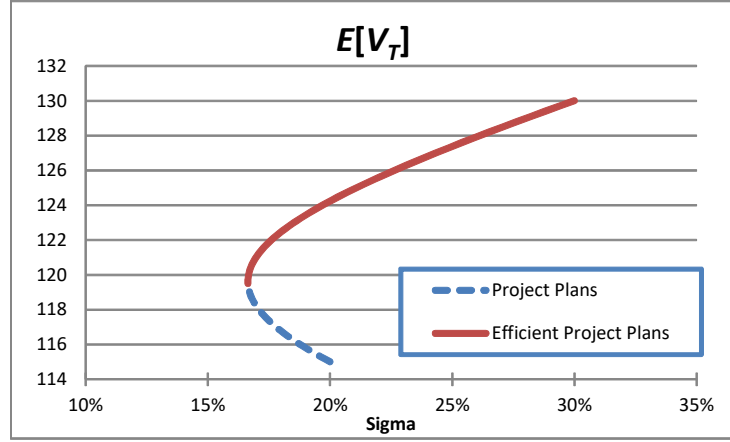


Figure 5.18: Expected bank value $E[V_T]$ for different values of w

there exists a minimum-variance plan w_{\min} with $\sigma_{\min} < \sigma_2$ given by,

$$w_{\min} = \frac{\sigma_2^2 - \rho\sigma_1\sigma_2}{\sigma_1^2 + \sigma_2^2 - 2\rho\sigma_1\sigma_2} \quad (5.65)$$

$$\sigma_{\min} = \sigma(w_{\min}) = \frac{(1-\rho^2)\sigma_1^2\sigma_2^2}{\sigma_1^2 + \sigma_2^2 - 2\rho\sigma_1\sigma_2}.$$

Project plans $w \in [w_{\min}, 1]$ then represent the set of efficient plans, with $\sigma \in [\sigma_{\min}, \sigma_1]$. In this region then,

$$\frac{d\sigma}{dw} > 0 \text{ for } \sigma \in (\sigma_{\min}, \sigma_1] \quad (5.66)$$

where

$$\frac{d\sigma}{dw} = \frac{1}{\sigma} [w\sigma_1^2 - (1-w)\sigma_2^2 + (1-2w)\rho\sigma_1\sigma_2]. \quad (5.67)$$

Fig 5.18 depicts the graph of $E[V_T]$ for different values of $w \in [0, 1]$, with its minimum-variance plan and the efficient plans on the upper branch.

The bank discounts the chosen project plan at the risk-adjusted rate $r(w, \sigma(w))$,

where $\frac{dr}{d\sigma} > 0$. The current market value of the bank is then given by,

$$V_0(w) = e^{-r(w, \sigma(w))T} E[V_T(w)]. \quad (5.68)$$

5.5.2 The First-best Optimal Plan

The first-best optimal plan for the bank is w^* such that

$$w^* = \arg \max_{w \in [w_{\min}, 1]} V_0(w). \quad (5.69)$$

To find the optimal plan we compute and equate to zero the derivative,

$$\frac{dV_0}{dw}(w) = -T \frac{dr}{dw} e^{-r(w, \sigma(w))T} E[V_T(w)] + e^{-r(w, \sigma(w))T} (E[V_T^1] - E[V_T^2]). \quad (5.70)$$

To rule out corner solutions, we require $\frac{dV_0}{dw}(w_{\min}) > 0$ and $\frac{dV_0}{dw}(1) < 0$. In particular, for the case $r(w, \sigma(w)) \equiv r(\sigma(w)) \Rightarrow \frac{dr}{dw} = \frac{dr}{d\sigma} \frac{d\sigma}{dw}$, then as $\frac{d\sigma}{dw} = 0$ at $w = w_{\min}$,

$$\frac{dV_0}{dw}(w_{\min}) = e^{-r(\sigma_{\min})T} (E[V_T^1] - E[V_T^2]) > 0. \quad (5.71)$$

As this is strictly positive the solution cannot be at this point, i.e. $w^* > w_{\min}$. At $w = 1$, as then $E[V_T(1)] = E[V_T^1]$, $\sigma(1) = \sigma_1$ and $\frac{d\sigma}{dw}(1) = \sigma_1 - \rho\sigma_2$,

$$\frac{dV_0}{dw}(1) = e^{-r(1, \sigma_1)T} \left[-T \frac{dr}{d\sigma} (\sigma_1 - \rho\sigma_2) E[V_T^1] + (E[V_T^1] - E[V_T^2]) \right]. \quad (5.72)$$

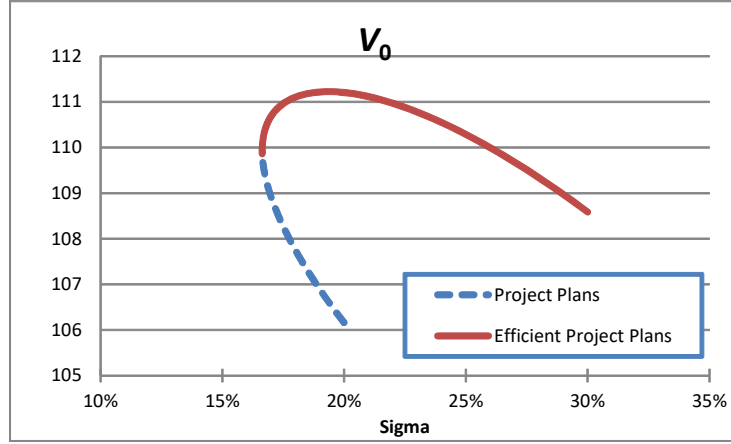


Figure 5.19: Bank's present value V_0 for different values of w

Then for an interior solution w^* that satisfies

$$\frac{dV_0}{dw}(w^*) = 0, \quad (5.73)$$

we require $\frac{dV_0}{dw}(1) < 0$, i.e.

$$\frac{E[V_T^1] - E[V_T^2]}{T(\sigma_1 - \rho\sigma_2)E[V_T^1]} < \frac{dr}{d\sigma}(1). \quad (5.74)$$

What condition (5.74) implies is that, for the solution to be internal, the project plan risk requires to be sufficiently costly (the right-hand side is large), or otherwise the bank would simply choose $w^* = 1$, i.e. only invest in the project with the highest expected value. Fig 5.19 depicts the graph of the present value V_0 . The optimal plan w^* is given by the curve's maximum point.

Example 2 (Constant Market Price of Risk)

$$r(w, \sigma(w)) = r_f + \lambda \sigma. \quad (5.75)$$

where λ is the constant market price of risk and r_f is the market risk-free rate. Then $\frac{dr}{dw} = 0$ and $\frac{dr}{d\sigma} = \lambda$ and so an internal solution exists for $\lambda > \frac{E[V_T^1] - E[V_T^2]}{T(\sigma_1 - \rho\sigma_2)E[V_T^1]}$.

Example 3 (Linear Average Market Price of Risk)

$$r(w, \sigma(w)) = r_f + \lambda(w) \sigma(w). \quad (5.76)$$

where $\lambda(w)$ is given by the weighted average of the respective market prices of risk of the two projects, λ_1 and λ_2 ,

$$\lambda(w) = w\lambda_1 + (1 - w)\lambda_2. \quad (5.77)$$

For our numerical analyses in this section including figure 5.2 we use the linear average market price of risk given in Example 3.

5.5.3 CAPM Discussion

As opposed to the above example, in the Capital Asset Pricing Model (CAPM) the risk-adjusted rate of return is linear in w ,

$$r(w) = wE[r_1] + (1 - w)E[r_2] = r_f + [w\beta_1 + (1 - w)\beta_2]MRP \quad (5.78)$$

where MRP is the market risk premium $MRP = E[r_M] - r_f$ and $E[r_M]$ is the expected market return rate. In this case then, $\frac{dr}{dw} = (\beta_1 - \beta_2) MRP$, and so,

$$\frac{dV_0}{dw}(w) = -T(\beta_1 - \beta_2) MRP e^{-r(w)T} E[V_T(w)] + e^{-r(w)T} (E[V_T^1] - E[V_T^2]), \quad (5.79)$$

for which,

$$\begin{aligned} \frac{dV_0}{dw}(1) &= -T(\beta_1 - \beta_2) MRP e^{-E[r_1]T} E[V_T^1] + e^{-E[r_1]T} (E[V_T^1] - E[V_T^2]) \\ &= [1 - T(\beta_1 - \beta_2) MRP] e^{-E[r_1]T} E[V_T^1] - e^{-E[r_1]T} E[V_T^2] \\ &\approx e^{-T(\beta_1 - \beta_2) MRP} (e^{-E[r_1]T} E[V_T^1] - e^{T(\beta_1 - \beta_2) MRP} e^{-E[r_1]T} E[V_T^2]) \\ &= e^{-T(\beta_1 - \beta_2) MRP} (V_0^1 - V_0^2). \end{aligned} \quad (5.80)$$

This is positive assuming $V_0^1 > V_0^2$. Hence there is no internal solution for the optimal plan for the bank. Specifically, the bank would always simply choose the riskier project 1.

The reason for this is that, with CAPM, the project-specific idiosyncratic risks are assumed to have been diversified away. In contrast in the constant and linear average λ example, for sufficiently low ρ there is risk-diversification effect such that a combination of the two projects has a higher present value than the present values of the single projects due to the lower risk-adjusted discount rate.

5.5.4 Equityholders' Choice of Risk

In the above section we established the bank's first-best choice of risk. However it is the equityholders who choose the bank's project plan. In this section we investigate their choice under different scenarios of no Bail-out/in, government Bail-out, equity-conversion

CoCo bond Bail-in and write-off CoCo bond Bail-in. For this we build a model of indifference curve analysis. The payoffs and the valuations under Merton (1974) framework for each of the restructuring scenarios were derived in detail in Chapter 5.1.

No Bail-Out/In and Government Bail-Out

As discussed in Chapter 5.1, the equityholders' payoff is the same under the cases of no Bail-out/in and the government Bail-out, where their payoff equals that of a call option with strike price F . The value of this is given by the familiar Black-Scholes option pricing formula,

$$V_{EE}^N = V_{EE}^{BO} = C(F) \quad (5.81)$$

where $C(K)$ is given in (5.4).

The equityholders' *indifference curves* (ICs) are defined as the loci of pairs (V_0, σ) that yields the same value of V_{EE}^N , i.e. all values of V_0 and σ such that,

$$V_{EE}^N(V_0, \sigma) = V \quad (5.82)$$

for a given value of V . We list some properties of the ICs:

Properties 5.1 (Equityholders' Indifference Curves) *The ICs have the following properties:*

1. *The ICs are downward-sloping.*
2. *The ICs are quasi-concave.*
3. *Given V_{EE}^N , the IC steepens as F increases, pivoted at $\sigma = \infty$.*

Proof. From the definition of the ICs,

$$\begin{aligned} dV_{EE}^N &= \frac{\partial V_{EE}^N}{\partial V_0} dV_0 + \frac{\partial V_{EE}^N}{\partial \sigma} d\sigma = 0 \\ \Leftrightarrow \frac{dV_0}{d\sigma} &= -\frac{\partial V_{EE}^N / \partial \sigma}{\partial V_{EE}^N / \partial V_0} = -\frac{vega^N}{\Delta^N} = MRS^N. \end{aligned} \quad (5.83)$$

MRS is the marginal rate of substitution between V_0 and σ along the IC, and,

$$\begin{aligned} \Delta^N &= N(d_1) \\ Vega^N &= V_0 \sqrt{T} N'(d_1). \end{aligned} \quad (5.84)$$

Immediately, ICs are downward-sloping as both Δ^N and $vega^N$ are strictly positive,

$$MRS^N = -\frac{V_0 \sqrt{T} N'(d_1)}{N(d_1)} < 0. \quad (5.85)$$

To check the curvature of the ICs, consider the limits of σ . First when it becomes large, using the limiting properties of call option values outlined in Properties B1 of Appendix 5.7.4,

$$\lim_{\sigma \rightarrow \infty} V_{EE}^N = V_0 \quad (5.86)$$

i.e. the equityholders' position approximates the asset value. Therefore at this point $\Delta = 1$ and $vega = 0$, and hence $MRS^N \rightarrow 0$ as σ becomes large. At the other limit when σ approaches zero, again from Property B1,

$$\lim_{\sigma \rightarrow 0} V_{EE}^N = \max [V_0 - F e^{-rT}, 0]. \quad (5.87)$$

On an IC where $V_{EE}^N > 0$ then, V_0 must unambiguously be greater than Fe^{-rT} as $\sigma \rightarrow 0$. Therefore, at this point the equityholders' position approximates the value of the forward $V_0 - Fe^{-rT}$, and thus again $\Delta = 1$ and $vega = 0$, making $MRS^N \rightarrow 0$ as $\sigma \rightarrow 0$. Given that $MRS^N < 0$ for $\sigma \in (0, \infty)$, the curves must therefore be quasi-concave.²⁵ Finally, as F increases V_0 has to adjust in order to keep V_{EE}^N constant for given σ ,

$$\begin{aligned} dV_{EE}^N &= \frac{\partial V_{EE}^N}{\partial F} dF + \frac{\partial V_{EE}^N}{\partial V_0} dV_0 = 0 \\ \Leftrightarrow \frac{dV_0}{dF} &= -\frac{\partial V_{EE}^N / \partial F}{\partial V_{EE}^N / \partial V_0} = \frac{e^{-rT} N(d_2)}{N(d_1)} > 0 \text{ for } \sigma < \infty. \end{aligned} \quad (5.89)$$

Therefore the IC shifts up. To show that this shift is a steepening of the curve pivoted at $\sigma = \infty$, note first that $\lim_{\sigma \rightarrow \infty} \frac{dV_0}{dF} = 0$. At any other values of σ ,

$$\begin{aligned} \frac{dMRS^N}{dF} &= \frac{\partial MRS^N}{\partial F} + \frac{\partial MRS^N}{\partial V_0} \frac{dV_0}{dF} \\ &= \left[-\frac{V_0}{F\sigma} \frac{N'(d_1)}{N(d_1)} \left(d_1 + \frac{N'(d_1)}{N(d_1)} \right) \right] + \left[\frac{N'(d_1)}{\sigma N(d_1)} \left(d_2 + \frac{N'(d_1)}{N(d_1)} \right) \right] \frac{e^{-rT} N(d_2)}{N(d_1)} \\ &= -\frac{N'(d_1)}{\sigma N(d_1)} \left[\frac{V_{EE}^N}{FN(d_1)} \left(d_1 + \frac{N'(d_1)}{N(d_1)} \right) + \sigma \sqrt{T} \frac{e^{-rT} N(d_2)}{N(d_1)} \right] < 0. \end{aligned} \quad (5.90)$$

The final line is negative $\forall \sigma < \infty$ as each term within it are positive except for d_1 , and $xN(x) + N'(x) > 0 \forall x$ which is shown in Property A2 of Appendix 5.7.3. Thus the ICs steepens as F increases. ■

²⁵The curvature of the ICs is given by,

$$\frac{d^2 V_0}{d\sigma^2} = \frac{\partial}{\partial \sigma} \left(\frac{dV_0}{d\sigma} \right) + \frac{\partial}{\partial V_0} \left(\frac{dV_0}{d\sigma} \right) \frac{dV_0}{d\sigma} = -\frac{V_0 \sqrt{T}}{\sigma} \frac{N'(d_1)}{N(d_1)} \left[\left(\frac{N'(d_1)}{N(d_1)} + d_2 \right)^2 + d_2 \sigma \sqrt{T} \right]. \quad (5.88)$$

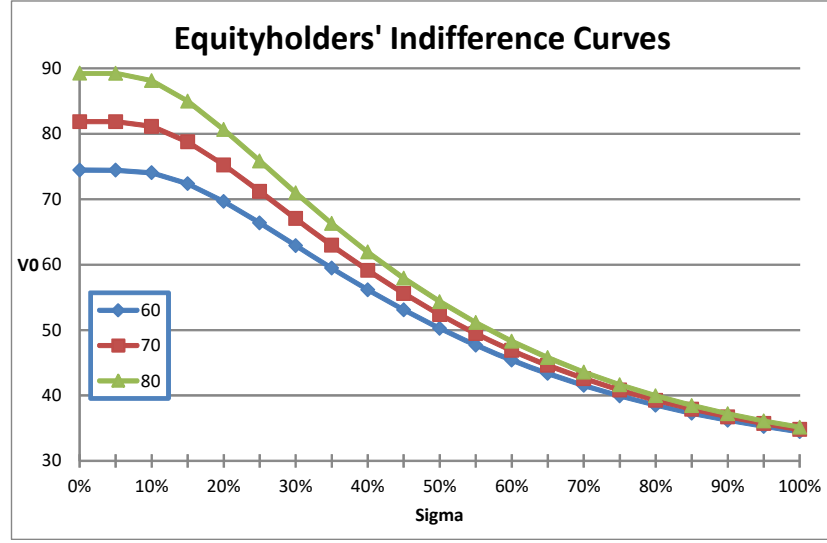


Figure 5.20: Equityholders' indifference curves for different debt levels F

These properties are demonstrated in Fig 5.20. The equityholders' optimisation problem is the selection of the highest attainable indifference curve given project plans (5.68). Diagrammatically, the solution is given by the tangent point shown in Fig 5.21. The graph suggests that the equityholders would choose a higher risk project plan w^N than the bank's first-best choice w^* . More formally,

Proposition 5.10 $w^N > w^*$.

Proof. The equityholders' choice of the optimal project plan is determined by,

$$\max_{w \in [w_{\min}, 1]} V_{EE}^N = C(F) \text{ subject to } V_0(w) = e^{-r(w, \sigma(w))T} E[V_T(w)]. \quad (5.91)$$

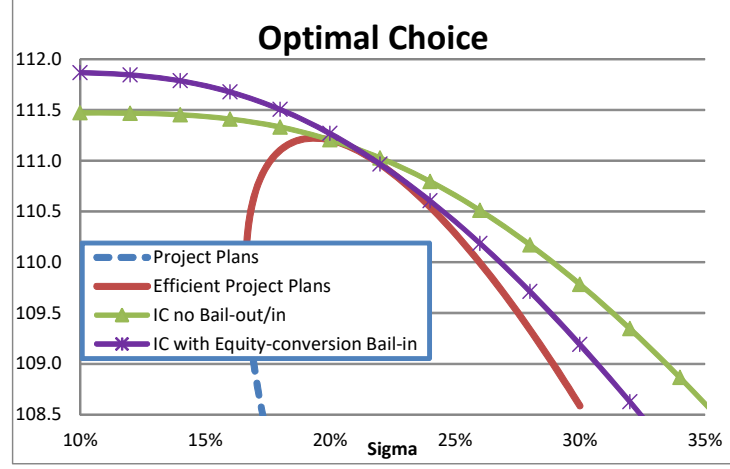


Figure 5.21: Equityholders' optimal choice with (i) no Bail-out/in, and (ii) Bail-in-Bail-in.

The solution w^N is the w that satisfies,

$$\frac{dV_{EE}^N}{dw}(w) = \frac{\partial V_{EE}^N}{\partial V_0} \frac{dV_0}{dw} + \frac{\partial V_{EE}^N}{\partial \sigma} \frac{d\sigma}{dw} = N(d_1(F)) \frac{dV_0}{dw}(w) + V_0 \sqrt{T} N'(d_1(F)) \frac{d\sigma}{dw}(w) = 0. \quad (5.92)$$

However at w^* , we know from (5.73) that $\frac{dV_0}{dw}(w^*) = 0$. On the other hand $\frac{d\sigma}{dw} > 0$ for $w \in [w_{\min}, 1]$, and therefore $\frac{dV_{EE}^N}{dw} > 0$ at w^* . Hence $w^N > w^*$. ■

The indifference curve analysis is particularly useful as it demonstrates clearly the agency costs associated with having the equityholders as the decision maker of firm's risk-taking. As proved the equityholders select a higher risk project plan w^N compared with the firm value maximising w^* . Immediately then, by equityholders optimising the value of their holdings and not that of the firm, it results in value destruction of the firm. As already discussed, this is one type of agency costs. The other type is the wealth transfer. The equityholders' position is a long call option as given above, the value of which increases with

the increase in the risk chosen. In contrast, for the no Bail-out/in scenario the bondholders hold a short put option, as derived in (5.3),

$$V_{DB}^N = Fe^{-rT} - P(F) \quad (5.93)$$

where $P(K)$ is the value of a put option given in (5.4). Put-call parity²⁶ implies that V_{DB}^N decreases by the same amount as the increase in V_{EE}^N with the increase in the risk. The equityholders' choice of w^N away from the first-best w^* therefore results in the wealth being transferred from the bondholders to the equityholders. On the other hand the bondholders are unaffected in the government Bail-out scenario, as in this case the bondholders' position is guaranteed at F as was shown in (5.7):

$$V_{DB}^{BO} = Fe^{-rT}. \quad (5.94)$$

In this case then, the wealth transfer is from the taxpayers to the equityholders.

We can also state the following:

Proposition 5.11 *The risk-taking is higher, the higher the leverage.*

Proof. This follows immediately from the third property of Properties 5.1 - the steeper the IC, the further along to the right the tangent point is in Fig 5.21. ■

This implies higher agency costs for higher leveraged banks.

²⁶The *put-call parity* states that, for a non-dividend paying underlying asset, the value of a call option plus a bond equals the value of a put option plus the underlying asset, i.e. $C(K) + Ke^{-rT} = P(K) + S$. As values of the bond or the underlying asset do not depend on the volatility of the underlying asset price, an increase in the volatility therefore must induce the same increase in the values of the call and the put options.

Equity-conversion Bail-in

We apply the same analysis to equity-conversion Bail-in. For simplicity we choose the Bail-in-Bail-in case analysed in Chapter 5.1.5 Case 3. There it was established that the equityholders' position is given by (see (5.19)),

$$V_{EE}^{CBI} = C(F) + \left[(1 - \tau) P\left(\frac{F}{1 - \tau}\right) - P(F) \right]. \quad (5.95)$$

The equityholders' project plan choice w^C is then determined by,

$$\max_{w \in [w_{\min}, 1]} V_{EE}^{CBI} \text{ subject to } V_0(w) = e^{-r(w, \sigma(w))T} E[V_T(w)]. \quad (5.96)$$

Firstly,

Proposition 5.12 *For $V_0 > \frac{F}{1-\tau}$, the IC for Bail-in is below the IC for no Bail-out/in with the same equityholders' value, $V_{EE}^N = V_{EE}^{CBI}$.*

Proof. Consider the ICs, IC^N and IC^{CBI} , with the same values for equityholders $V_{EE}^N = V_{EE}^{CBI} > 0$. First investigate what happens when $\sigma \rightarrow 0$. Applying Properties B1 in Appendix 5.7.4, when $V_0 > \frac{F}{1-\tau}$,

$$\lim_{\sigma \rightarrow 0} V_{EE}^N = \lim_{\sigma \rightarrow 0} V_{EE}^{CBI} = V_0 - F e^{-rT}. \quad (5.97)$$

Hence $V_0^N(0) = V_0^{CBI}(0)$ at $\sigma = 0$, where $V_0^N(\sigma)$ and $V_0^{CBI}(\sigma)$ are the values of V_0 required to attain a given equityholders' value V_{EE}^N when the volatility is σ . Similarly for

$\sigma \rightarrow \infty$, again using Properties B1,

$$\lim_{\sigma \rightarrow \infty} V_{EE}^N = \lim_{\sigma \rightarrow \infty} V_{EE}^{CBI} = V_0, \quad (5.98)$$

and thus $V_0^N(\infty) = V_0^{CBI}(\infty)$ at $\sigma = \infty$. Finally for $\sigma \in (0, \infty)$, note that

$$(1 - \tau) P\left(\frac{F}{1 - \tau}\right) - P(F) > 0 \quad \forall \sigma \in (0, \infty), \quad (5.99)$$

as $(1 - \tau) \max\left[\frac{F}{1 - \tau} - V_0, 0\right] = \max[F - (1 - \tau)V_0, 0] > \max[F - V_0, 0]$ at all values of V_0 .

Thus to equate V_{EE}^{CBI} with V_{EE}^N for a given $\sigma \in (0, \infty)$, $V_0^{CBI}(\sigma)$ must be smaller than $V_0^N(\sigma)$. ■

The proposition states that in order to attain the same equityholders' value $V_{EE}^N = V_{EE}^{CBI}$, the equityholders are able to choose a lower $V_0(w)$ for a given σ under Bail-in than under no Bail-out/in. The condition $V_0 > \frac{F}{1 - \tau}$ assures that the firm is not already in distress at time 0. Fig 5.22 demonstrates this result.

Secondly, Fig 5.21 suggests that the equityholders would choose a higher risk project plan w^{CBI} under Bail-in than w^N under no Bail-out/in:

Proposition 5.13 $w^{CBI} > w^N$.

Proof. From (5.92), the solution w^N satisfies,

$$\begin{aligned} \frac{dV_{EE}^N}{dw}(w^N) &= \frac{\partial V_{EE}^N}{\partial V_0} \frac{dV_0}{dw}(w^N) + \frac{\partial V_{EE}^N}{\partial \sigma} \frac{d\sigma}{dw}(w^N) = 0 \\ \Leftrightarrow \frac{dV_0}{dw}(w^N) &= -\frac{Vega_{EE}^N}{Delta_{EE}^N} \frac{d\sigma}{dw}(w^N). \end{aligned} \quad (5.100)$$

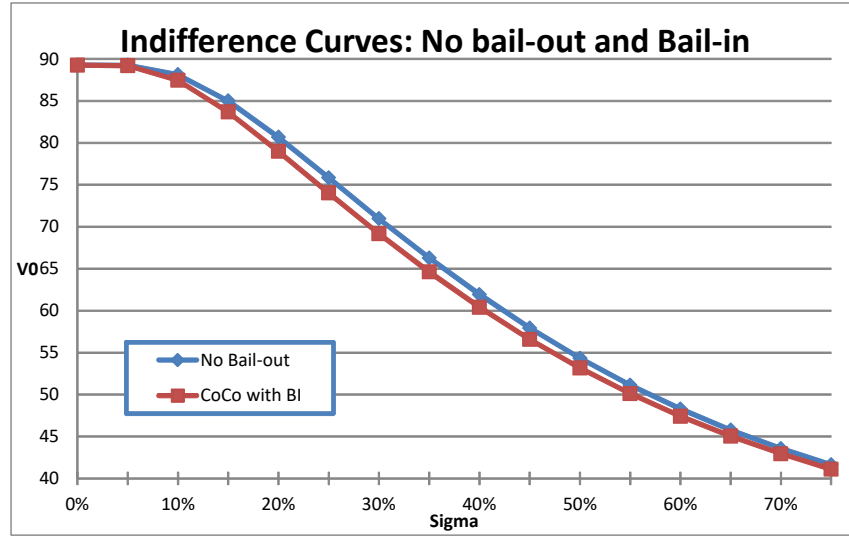


Figure 5.22: Equityholders' indifference curves for (i) no Bail-out/in and (ii) Bail-in-Bail-in cases

Similarly, the solution w^{CBI} for (5.96) is w that satisfies,

$$\begin{aligned}
 \frac{dV_{EE}^{CBI}}{dw}(w) &= \frac{\partial V_{EE}^{CBI}}{\partial V_0} \frac{dV_0}{dw}(w) + \frac{\partial V_{EE}^{CBI}}{\partial \sigma} \frac{d\sigma}{dw}(w) \\
 &= \text{Delta}_{EE}^{CBI} \times \frac{dV_0}{dw}(w) + \text{Vega}_{EE}^{CBI} \times \frac{d\sigma}{dw}(w) = 0.
 \end{aligned} \tag{5.101}$$

Now at w^N , using (5.100),

$$\frac{dV_{EE}^{CBI}}{dw}(w^N) = \text{Vega}_{EE}^N \left(-\frac{\text{Delta}_{EE}^{CBI}}{\text{Delta}_{EE}^N} + \frac{\text{Vega}_{EE}^{CBI}}{\text{Vega}_{EE}^N} \right) \frac{d\sigma}{dw}(w^N). \tag{5.102}$$

However, we already know from Proposition 5.6 that $\Delta_{E_E}^{CBI} < \Delta_{E_E}^N$, and from Proposition 5.3 that $Vega_{E_E}^{CBI} > Vega_{E_E}^N$, when $V_0 > \frac{F}{1-\tau}$. Hence,

$$\frac{Vega_{E_E}^{CBI}}{Vega_{E_E}^N} > 1 > \frac{\Delta_{E_E}^{CBI}}{\Delta_{E_E}^N} \Rightarrow \frac{dV_{E_E}^{CBI}}{dw}(w^N) > 0. \quad (5.103)$$

Thus at w^N the equityholders are still able to increase its value by increasing w . Hence $w^{CBI} > w^N$.²⁷ ■

As demonstrated in Fig 5.21, this means that under Bail-in, the equityholders would choose an efficient project plan with higher σ but lower V_0 , implying an aggravation of both wealth transfer and value destruction agency costs compared with no Bail-out/in.

Write-off CoCo Bond Bail-in

Finally, we consider the write-off CoCo bond bail-in. In (5.27) we established that the equityholders' position is given by (here for notational simplification, we denote

$$V_{E_E}^W = V_{E_E}^{WOBI} + V_{E_{CCR}}^{WOBI},$$

$$V_{E_E}^W = C(F) + F_W B_P \left(\frac{F}{1-\tau} \right) - \left[P(F) - (1-\tau) P \left(\frac{F_B}{1-\tau} \right) \right], \quad (5.104)$$

²⁷An alternative intuitive proof is as follows. (5.95) shows that the equityholders' position under equity-conversion Bail-in is the no Bail-out/in position $V_{E_E}^N = C(F)$ plus a long put bear spread-like structure $(1-\tau) P \left(\frac{F}{1-\tau} \right) - P(F)$, which represents the CoCo bail-in guarantee. For the range of values of V_0 and F that we are interested, the delta of this long put bear spread is negative. The vega of a put bear spread is always positive. This implies that $\Delta_{E_E}^{CBI} < \Delta_{E_E}^N$ and $Vega_{E_E}^{CBI} > Vega_{E_E}^N$. In (5.83) we derived that the slope of the IC is the MRS which is the negative of the ratio of vega to delta. Therefore MRS^{CBI} is more negative than MRS^N , implying a steeper IC under Bail-in than under no Bail-out/in. Thus $w^{CBI} > w^N$.

where again $B_P(K)$ is the price of the binary put option with unit payout at strike K given in (5.23). The equityholders' project plan choice w^W is then determined by,

$$\max_{w \in [w_{\min}, 1]} V_{EE}^W = C(F) + F_W B_P\left(\frac{F}{1-\tau}\right) - \left[P(F) - (1-\tau) P\left(\frac{F_B}{1-\tau}\right) \right] \quad (5.105)$$

subject to $V_0(w) = e^{-r(w, \sigma(w))^T T} E[V_T(w)]$.

Then,

Proposition 5.14 $w^W > w^N$.

Proof. Very similar to the proof of Proposition 5.13. ■

5.5.5 Simulated Results

To compare the outcomes between the different restructuring structures, we simulate the optimal risk chosen by the equityholders under the different structures for varying values of F . This is done by numerically solving the equityholders' maximisation problems for each scenario, namely (5.91), (5.96) and (5.105), using Newton-Raphson numerical estimation to solve for the values w such that $\frac{dV_{EE}^X}{dw} = 0$ for $X \in \{N, CBI, W\}$. This is then applied to (5.64) to compute the optimal $\sigma^X(w)$. The values used for the simulation are: $E[V_T^1] = 130$, $E[V_T^2] = 115$, $\sigma_1 = 30\%$, $\sigma_2 = 10\%$, $\rho = 0$, $\lambda_1 = 0.5$, $\lambda_2 = 0.25$, $T = 1$ and $r_f = 3\%$. Where required, the level of CoCo bond is assumed to be 10% of the total debt level, with the CoCo trigger level $\tau = 7\%$. The minimum capital ratio is $\underline{E} = 10\%$. Given these volatilities and the market risk premium, the present values of the two projects are

F	First-best	No Bail-out/in	Equity-conversion CoCo	Write-off CoCo
30	19.36%	19.36%	19.36%	19.36%
35	19.36%	19.36%	19.36%	19.36%
40	19.36%	19.36%	19.36%	19.36%
45	19.36%	19.36%	19.36%	19.36%
50	19.36%	19.36%	19.36%	19.36%
55	19.36%	19.36%	19.37%	19.37%
60	19.36%	19.37%	19.40%	19.43%
65	19.36%	19.40%	19.49%	19.57%
70	19.36%	19.50%	19.74%	19.93%
75	19.36%	19.75%	20.34%	20.73%
80	19.36%	20.34%	21.86%	22.49%
85	19.36%	21.81%	26.12%	26.30%
90	19.36%	26.45%	33.63%	32.41%
95	19.36%	36.00%	39.95%	38.34%

Figure 5.23: Simulated results for equityholders' risk choice for different leverage

$V_0^1 = 108.6$ and $V_0^2 = 106.2$. The simulated results for the optimal $\sigma(w)$ are shown in Fig 5.23. The graph of the results are plotted in Fig 5.24.

The results suggest the following,

- For low leverage, the risk chosen approaches the first-best.
- For higher leverage, the equityholders choose the risks in the ascending order of no Bail-out/in, equity-conversion CoCo bond bail-in and write-off CoCo bond bail-in.
- For very high leverage, equity-conversion bail-in induces higher risk-taking than the write-off structure.

The explanation for the last point is as follows. In the write-off CoCo bail-in, the

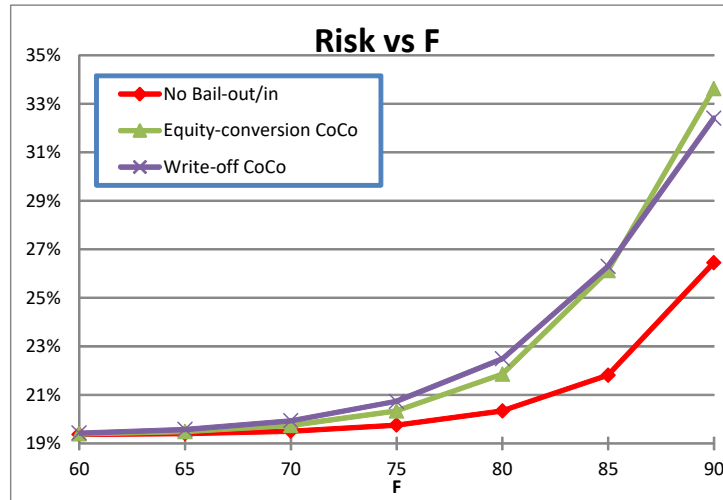


Figure 5.24: Equityholders' chosen risk for different leverage

jump up in the payoff for the equityholders at the strike price $\frac{F}{1-\tau}$ due to the binary put (as shown in Fig 5.8) implies that close to the strike price, the equityholders would actually prefer not to have high volatility as it reduces the probability of ending up with a high payoff (within the triangle area in Fig 5.2). This reduces the incentive for high risk-taking in high-leverage cases for the write-off bail-in structure.

Note, as before, here it is assumed that the government bail-out takes the form of ordinary shares capital injection. As discussed in Chapter 5.1.8, another possibility would be for the capital injection to be in the form of preference shares. As modelled, these two bail-out structures would have the same payoffs for the equityholders at the maturity T . In reality though the two would result in different behaviours by the equityholders. Specifically, the lack of dilution and the higher expected ROE would mean that the equityholders are more likely to take higher risks with the preference shares bail-out.

5.5.6 Monitoring Cost

The inevitable agency costs of bail-in should encourage bondholders to monitor equityholders' behaviour. This results in monitoring costs to the bondholders. For example, a passive asset manager who has been investing in financial bonds for its index tracking portfolio now needs fundamental analysts to monitor the credit quality of the banks. This is costly. Jensen and Meckling (1976) argue that these monitoring costs are ultimately borne by equityholders via higher cost of capital (WACC) demanded. The threat of the fall in the bank's value should in turn curb the bank's risk-taking behaviour and discipline equityholders. In this section we demonstrate this mechanism using the model developed above.

The rise in the return demanded by the investors, due to the monitoring costs, is here represented by an increase in the price of risk for the higher risk project 1 from λ_1 to λ'_1 . This is the higher WACC of choosing a higher proportion of the riskier project. As a result, the present value of the project plans are reduced for the riskier choices. This is depicted in Fig 5.25 by the "squeezing" of the project plans frontier. In again selecting the tangent point with their ICs (here with equity-conversion CoCo bond bail-in), the equityholders' optimal choice of project plan is now of a lower risk.

In policy terms this is analogous to Pigouvian tax. The agency costs are the negative externality of equityholders' actions on the remaining stakeholders of the bank. By implementing higher costs on their action, the regulators can force the equityholders to select less risky choice. As a demonstration, Fig 5.26 simulates the resulting behaviour of the equityholders with varying degrees of increase in λ_1 , when $F = 80$. It shows that with

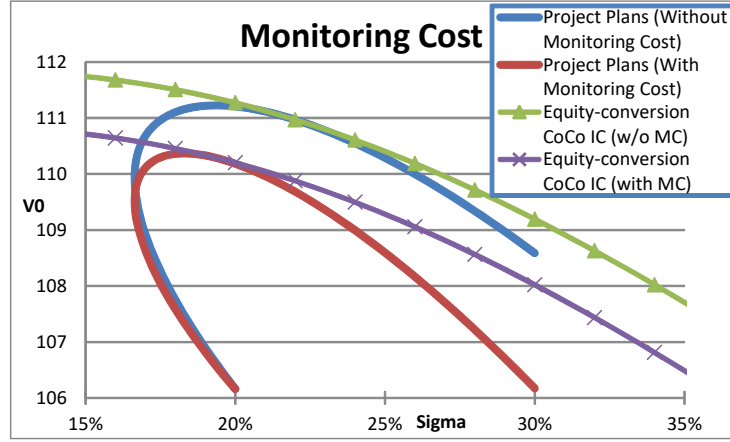


Figure 5.25: Effect of Monitoring Cost on Equityholders' Choice of Risk

sufficient rise in the cost of choosing the riskier project, the equityholders can be made to choose the first-best risk level for all structures. There is, however, a social cost of the value of firm being lowered as a result, as shown in Fig 5.25.

More formally,

Proposition 5.15 *The higher the required rate of return of the riskier project 1, the lower the equityholders' choice of risk.*

Proof. To show this, consider two downward-sloping curves as a function of a variable x , $f(x; \phi)$ and $g(x)$. ϕ is an exogenous parameter. Let the derivatives of the functions be such that $f_x < 0$, $g_x < 0$, $f_{xx} < g_{xx}$, $f_{xx} < 0$ and $f_{x\phi} < 0$. This implies that, (i) $f(x; \phi)$ is strictly concave in x ; (ii) $g(x)$ is less concave than $f(x)$ and can even be linear or convex; and (iii) $f(x; \phi)$ becomes steeper (more downward-sloping) with an increase in ϕ . Let now x^* be the value of x where the two curves are tangent, i.e. $f_x(x^*; \phi) = g_x(x)$.

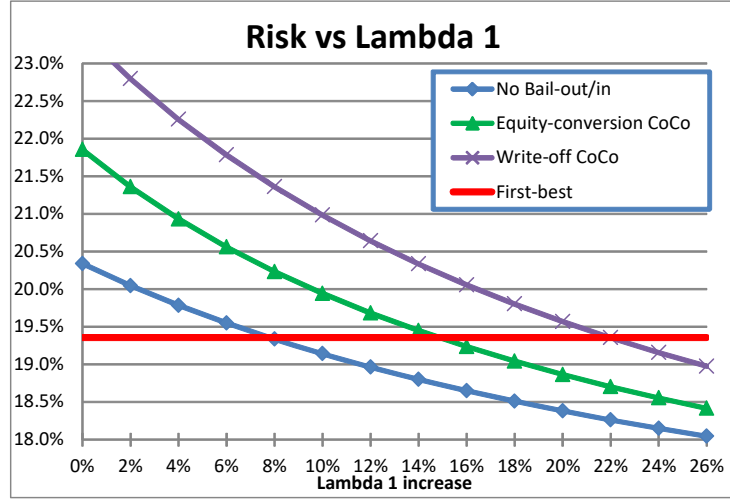


Figure 5.26: Risk chosen with Monitoring Cost

Then as ϕ increases,

$$\frac{d}{d\phi} f_x(x^*; \phi) = f_{xx} \frac{dx^*}{d\phi} + f_{x\phi}. \quad (5.106)$$

For the two curves to be tangent again, this must equal $\frac{d}{d\phi} g_x(x^*) = g_{xx} \frac{dx^*}{d\phi}$. Thus,

$$\frac{dx^*}{d\phi} = \frac{f_{x\phi}}{g_{xx} - f_{xx}} < 0. \quad (5.107)$$

This is negative from the conditions on the derivatives. Our tangency analysis between the concave project plan curves ($f(x; \phi)$) and the quasi-concave ICs ($g(x)$) satisfy these conditions, where $x = \sigma$ and $\phi = \lambda_1$. Hence the choice of σ decreases with higher λ_1 . ■

Moreover, the size of this effect depends on how far the bank's balance sheet is from the trigger level,

Proposition 5.16 *The equityholders react more to the rise in the riskier project's required*

rate of return, the further away the bank is from the restructuring point.

Proof. We have seen in Properties 5.1 that the ICs are concave when V_0 is far above the restructuring point but turns convex closer to it. This means that g_{xx} turns from negative to positive as V_0 falls towards the restructuring point, implying decreasing $\frac{dx^*}{d\phi}$. ■

Given these results, we can now propose financial and non-financial covenants as the best way to articulate the monitoring effort.

5.6 Concluding Remarks

The new financial regulation has been articulated to dampen moral hazard and to minimize the chances of another financial crisis that could jeopardize again the integrity of the banking system. However in reality, the regulator is “swapping” Bail-out for Bail-in, which is in essence the intended replacement of moral hazard with agency costs. If the burden of an ailing bank fell to the taxpayers in the past, it will now fall to the bondholders. Historically, apart from the very few cases where the bank was fully nationalized (e.g. Bankia in 2012; SNS in 2013, Banco Espirito Santo in 2014, etc.), the equityholders would simply suffer dilution (e.g. Lloyds and ING, both in 2008), or, in many cases, were unaffected with the injection of new equity in the form of preference shares with CT1 qualification (Goldman Sachs, Morgan Stanley, etc.). Under the new Bail-in regime, the equityholders take the first losses up to the CoCo trigger point where bondholders get writedown/off or converted into a non-admissible DES, while there is still at least 7.0% of assets in equity. This going-concern DAPR accentuates the agency costs that the Bail-in structure is introducing into the banking industry, as demonstrated in this chapter.

It is, moreover, possible that the new Bail-in structure may even aggravate the moral hazard problem. One could argue that the equityholders have more incentives to “gamble for resurrection” when the wealth extraction comes from other investors (creditors) instead of taxpayers, as the media scrutiny, and hence the "reputational" impact, would likely be lower. Further, Bail-in may not result in restrictions on dividends²⁸ or bankers’ compensations as there would be with taxpayer Bail-out. While these are issues not analysed in this paper, they enhance our case that the new financial regulation may not alleviate the incentive problems as aimed.

Traditional Corporate Finance literature has underscored the detrimental effects of agency costs on the relationships between bondholders and equityholders, especially due to the limited investment of the latter. Higher equity advocated by some (e.g. Admati *et al.*, 2013) does not attenuate the problem when the equityholders enjoy the implicit put of the Bail-in-able balance sheet. Higher capital costs on risky investments (Risk-Weighted Asset inflation) could potentially make banks safer, however banks are volatile institutions with Non-Performing Loans and speculative trading that makes the business unpredictable. Equityholders are aware of this and they will exploit the opportunity to deviate from the Capital Asset Line in the Capital Asset Pricing Model, pursuing low Sharpe Ratio “bets” and speculate with the DAPR offered by the bondholders’ put. The aggravation of this agency cost will trespass the bank’s balance sheet to penetrate into the asset management industry (as the major owners of the bank’s debt), and ultimately into

²⁸We are aware that the ECB alongside the Commission and EBA are looking into ways to prioritize CoCo coupon (for Additional Tier 1s, whose coupons are discretionary) payments when discretionary payments (dividend, bonuses and AT1s coupons) are limited due to regulatory prohibitions (Core Tier 1 falling below a threshold.payments) to somewhat restore the seniority due to the lack of dividend stoppers and pushers within AT1s bond indentures.

the real economy. In this chapter we have focused on several aspects that arise from our view within this new Bail-in world. Wealth-transfer and value destruction are two consequences of the dominance of equityholders in their private “game” against bondholders. This is even more pronounced when bondholders do not have the chance to lead the restructuring procedure to attain a fair agreement that partially compensates their losses, as would do in an admissible DES. Moreover, the DAPR brought about by Bail-in will change the profile of the trade-off between value and risk for equityholders. The relationship between risk and value becomes less concave and eventually convex as the solvency “flirts” with PONV, and equityholders can boost the riskiness of the assets without sacrificing too much of the value of the bank (in technical term the ratio of vega to delta decreases, and hence more volatility can be traded for less value). This is more acute with write-off CoCo bond Bail-in than with equity-conversion CoCo, however, under both structures, the high risk-taking appetite of equityholders are higher relative to the traditional Bail-out (lBail-out/in outcome was the same as the no Bail-out/in one) as demonstrated in this Chapter. Consequently, we believe that bondholders’ monitoring costs would rise, as they will not passively wait to be reimbursed while the DAPR-induced agency costs lurk under the surface.

In conclusion, the new Bail-in regulations do not tackle the intrinsic moral hazard of the banking industry; instead they are “solutions” that could yield new unintended consequences (such as higher risk taking or "gamble for resurrection" as the solvency moves closer to the PONV). Unfortunately the inherent problems of the banking industry continue to lurk behind the scenes.

5.7 Appendix

5.7.1 Proof of $\frac{\partial}{\partial K} [N(-d_1(K)) - \lambda N(-d_1(\frac{K}{\lambda}))] < 0$ for $V_0 > \frac{K}{\lambda}$

Noting that $\frac{\partial}{\partial K} N(-d_1(K)) = \frac{1}{K\sigma\sqrt{T}} N'(-d_1(K))$,

$$\frac{\partial}{\partial K} \left[N(-d_1(K)) - \lambda N\left(-d_1\left(\frac{K}{\lambda}\right)\right) \right] = \frac{1}{K\sigma\sqrt{T}} \left[N'(-d_1(K)) - \lambda N'\left(-d_1\left(\frac{K}{\lambda}\right)\right) \right]. \quad (5.108)$$

This is negative if and only if,

$$\begin{aligned} \exp\left(-\frac{d_1^2(K)}{2}\right) &< \lambda \exp\left(-\frac{d_1^2(\frac{K}{\lambda})}{2}\right) \\ \Leftrightarrow d_1^2(K) &> d_1^2\left(\frac{K}{\lambda}\right) - 2\ln\lambda. \end{aligned} \quad (5.109)$$

Now $d_1\left(\frac{K}{\lambda}\right) = d_1(K) + \frac{\ln\lambda}{\sigma\sqrt{T}}$ and hence,

$$\begin{aligned} \Leftrightarrow d_1^2(K) &> d_1^2(K) + \frac{2\ln\lambda}{\sigma\sqrt{T}} d_1(K) + \frac{(\ln\lambda)^2}{\sigma^2 T} - 2\ln\lambda \\ \Leftrightarrow 0 &> \frac{\ln\lambda}{\sigma\sqrt{T}} \left[2\left(d_1(K) - \sigma\sqrt{T}\right) + \frac{\ln\lambda}{\sigma\sqrt{T}} \right]. \end{aligned} \quad (5.110)$$

As $d_1(K) - \sigma\sqrt{T} = d_2(K)$ and when $0 < \lambda < 1$, $\ln\lambda < 0$,

$$\begin{aligned} \Leftrightarrow 0 < d_2(K) + \frac{\ln\lambda}{2\sigma\sqrt{T}} &= d_2(K) + \frac{\ln\lambda}{\sigma\sqrt{T}} - \frac{\ln\lambda}{2\sigma\sqrt{T}} = d_2\left(\frac{K}{\lambda}\right) - \frac{\ln\lambda}{2\sigma\sqrt{T}} \\ \Leftrightarrow \frac{\ln\lambda}{2\sigma\sqrt{T}} &< d_2\left(\frac{K}{\lambda}\right). \end{aligned} \quad (5.111)$$

For $0 < \lambda < 1$ then the sufficient condition is that $d_2\left(\frac{K}{\lambda}\right) > 0 \Leftrightarrow V_0 > \frac{K}{\lambda} \exp^{-\left(r - \frac{\sigma^2}{2}\right)T}$,

which in turn is sufficiently satisfied for $V_0 > \frac{K}{\lambda}$ when $r > \frac{\sigma^2}{2}$.

5.7.2 Proof of Eq.(5.49) being Negative

First note that, at $F_W = 0$, $\Delta_{WDcdr} = 0$. Investigate what happens when F_W increases while keeping F constant,

$$\frac{\partial}{\partial F_W} \Delta_{WDcdr} = -\frac{e^{-rT}}{V_0 \sigma \sqrt{T}} N' \left(-d_2 \left(\frac{F}{1-\tau} \right) \right) + \frac{1}{F_B \sigma \sqrt{T}} N' (-d_1(F_B)). \quad (5.112)$$

Now note the following property of the Black-Scholes put option pricing formula:

$$P_0(K) = -S_0 N(-d_1(K)) + K e^{-rT} N(-d_2(K)) \Rightarrow S_0 N'(-d_1(K)) = K e^{-rT} N'(-d_2(K)). \quad (5.113)$$

Applying this here, $\frac{\partial}{\partial F_W} \Delta_{WDcdr} < 0$ if and only if,

$$\left(\frac{1-\tau}{F} \right) N' \left(-d_1 \left(\frac{F}{1-\tau} \right) \right) > \frac{1}{F_B} N'(-d_1(F_B)). \quad (5.114)$$

Analyze this:

$$\begin{aligned} &\Leftrightarrow -\left(d_1 \left(\frac{F}{1-\tau} \right)\right)^2 + (d_1(F_B))^2 > 2 \ln \left(\frac{F}{1-\tau} \frac{1}{F_B} \right) \\ &\Leftrightarrow \left[\ln \left(\frac{V_0}{F_B} \right) \right]^2 - \left[\ln \left(\frac{V_0(1-\tau)}{F} \right) \right]^2 + 2 \left(r + \frac{\sigma^2}{2} \right) T \ln \left(\frac{F}{1-\tau} \frac{1}{F_B} \right) > 2\sigma^2 T \ln \left(\frac{F}{1-\tau} \frac{1}{F_B} \right) \\ &\Leftrightarrow \left[\ln \left(\frac{V_0^2(1-\tau)}{F_B F} \right) \right] + 2 \left(r + \frac{\sigma^2}{2} \right) T > 2\sigma^2 T \\ &\Leftrightarrow V_0 > \left(\frac{F}{1-\tau} F_B \right)^{\frac{1}{2}} e^{-\left(r - \frac{\sigma^2}{2}\right)T}. \end{aligned} \quad (5.115)$$

This is certainly satisfied for $V_0 > \frac{F}{1-\tau}$ when $r > \frac{\sigma^2}{2}$. Hence $\Delta_{WDcdr} < 0$ unambiguously $\forall F_W$ for V_0 above the trigger point.

5.7.3 Properties of $N(x)$

$N(x)$ is the cumulative distribution function for a standard normally distributed random variable $X \sim N(0, 1)$ such that $N(x) = \Pr(X \leq x)$. Then $N'(x)$ is the probability density function $N'(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$.

Property A1

$$\begin{aligned} \lim_{x \rightarrow \infty} \frac{N'(x)}{N(x)} &= 0 \\ \lim_{x \rightarrow -\infty} \frac{N'(x)}{N(x)} &= -x. \end{aligned} \quad (5.116)$$

Proof. The first limit is trivial as $\lim_{x \rightarrow \infty} N'(x) = 0$ and $\lim_{x \rightarrow \infty} N(x) = 1$. For the second, note first that $\lim_{x \rightarrow -\infty} N'(x) = 0$ and $\lim_{x \rightarrow -\infty} N(x) = 0$. The limit can therefore be found using L'Hôpital's rule,

$$\lim_{x \rightarrow -\infty} \frac{N'(x)}{N(x)} = \lim_{x \rightarrow -\infty} \frac{N''(x)}{N'(x)} = \lim_{x \rightarrow -\infty} \frac{-xN'(x)}{N'(x)} = -x. \quad (5.117)$$

■

Property A2

$$\frac{d}{dx} \left(\frac{N'(x)}{N(x)} \right) < 0 \quad \forall x. \quad (5.118)$$

Proof. Expanding,

$$\frac{d}{dx} \left(\frac{N'(x)}{N(x)} \right) = -\frac{xN'(x)}{N(x)} - \left(\frac{N'(x)}{N(x)} \right)^2 = -\frac{N'(x)}{N(x)} \left(\frac{xN(x) + N'(x)}{N(x)} \right). \quad (5.119)$$

This is negative if and only if $xN(x) + N'(x) > 0$. This is obvious for $x \geq 0$. For $x < 0$, first check the limits,

$$\begin{aligned}\lim_{x \rightarrow 0} xN(x) + N'(x) &= N'(0) = \frac{1}{\sqrt{2\pi}} > 0 \\ \lim_{x \rightarrow -\infty} xN(x) + N'(x) &= \lim_{x \rightarrow -\infty} N(x) \left(x + \frac{N'(x)}{N(x)} \right) = 0\end{aligned}\tag{5.120}$$

using Property A1. Now,

$$\frac{d}{dx} (xN(x) + N'(x)) = N(x) + xN'(x) - xN'(x) = N(x) > 0 \quad \forall x \tag{5.121}$$

which proves that $xN(x) + N'(x) > 0 \quad \forall x < 0$. ■

5.7.4 Limiting Properties of Call and Put Options

Properties B1 (Properties at the limits of call and put option values)

1. For large σ ,

$$\left. \begin{aligned} \lim_{\sigma \rightarrow \infty} d_1 = \infty &\Rightarrow \lim_{\sigma \rightarrow \infty} N(d_1) = 1 \\ \lim_{\sigma \rightarrow \infty} d_2 = -\infty &\Rightarrow \lim_{\sigma \rightarrow \infty} N(d_2) = 0 \end{aligned} \right\} \Rightarrow \begin{cases} \lim_{\sigma \rightarrow \infty} C(K) = V_0 \\ \lim_{\sigma \rightarrow \infty} P(K) = Ke^{-rT} \end{cases} . \tag{5.122}$$

Therefore a call option behaves like the underlying asset while a put option behaves like a bond.

2. For $\sigma \rightarrow 0$,

$$\lim_{\sigma \rightarrow 0} d_1 = \lim_{\sigma \rightarrow 0} d_2 = \begin{cases} -\infty & \text{if } V_0 < Ke^{-rT} \\ 0 & \text{if } V_0 = Ke^{-rT} \\ \infty & \text{if } V_0 > Ke^{-rT} \end{cases} \Rightarrow \lim_{\sigma \rightarrow 0} N(d_1) = \lim_{\sigma \rightarrow 0} N(d_2) = \begin{cases} 0 \\ \frac{1}{2} \\ 1 \end{cases} .$$

(5.123)

Thus,

$$\begin{aligned} \lim_{\sigma \rightarrow 0} C(K) &= \max [V_0 - Ke^{-rT}, 0] \\ \lim_{\sigma \rightarrow 0} P(K) &= \max [Ke^{-rT} - V_0, 0] . \end{aligned}$$

(5.124)

Intuitively the options approximate their intrinsic values.

Chapter 6

Removing Agency Costs and Moral Hazard Under Bail-in

When a bank's solvency is deteriorating the bank usually has three options: issue equity, hoard capital (by suspending dividends and share repurchase) or delever (decrease assets). The last of these usually comes with pernicious and counterproductive consequences for the economy as the bank "freezes" lending and curtails investments that curbs the ordinary financing of companies and households. Equity issuance has its problems due to the potential lack of support of both equity insiders and outsiders; given the distressed financial situation of the bank, unless it finds the internal support from its equityholders base to raise the necessary equity at the current share price the bank would have to raise equity, and only if the market still has the appetite for it, at discount levels to secure sufficient interest. For these reasons, banks are now required to hold some types of contingent capital that automatically and seamless converts into equity to restore the solvency once the bank enters into a financial distress phase.

However, as analysed extensively in this thesis so far the new Basel III related Bail-in structures come with implicit problems, namely the agency costs and the moral hazard. There are at broadly two types of agency costs, the wealth transfer and the value destruction problems. The former arises from the convex nature of equityholders' payoffs. While they gain from the potential upside from any uncertain projects or investments, their

loss is limited to a level guaranteed implicitly by the tax payers (in a government Bail-out scenario) or by the bondholders (in a Bail-in scenario). This is equivalent to a put option written by the guarantor. The problem arises as here the holders of the option (the equityholders) have the decision-making right to select the riskiness of the business (akin to the option holders being able to choose the volatility of the underlying asset), meaning that they would rationally choose higher risk investments. This results in a wealth transfer from the guarantor to the equityholders. The value destruction problem refers to the negative externality associated with equityholders' decision; they would choose to undertake projects that have positive net present value (NPV) for them, even if it has a negative NPV for the bank as a whole. An extreme case of this is the "gamble-for-resurrection". These agency costs are present even in a traditional Absolute Priority Rule (APR), as pointed out in Chapter 5 where we established that the Bail-in structures are equivalent to a "CoCo condor" structure written by the bondholders and held by the equityholders, thereby the Basel III proposal actually aggravates the agency costs consequently.

More particularly, in Chapter 5 we develop an indifference curve model to prove the "augmented" convexity of the shareholders' payoff that arise from the Bail-in induced DAPR. This should definitely lead to monitoring costs from bondholders to avert any potential shareholders' "gamble for resurrection" as the solvency deteriorates and increase risk appetite from shareholders sets in.

We believe that the most efficient way for bondholders to monitor the credit quality and risk-taking profile of the bank is through the utilization of covenants, mirroring the practice in the corporate bond market. In this chapter we propose different types of covenants within the CoCo indentures as ways of tackling agency costs. When the firm's solvency is reasonably high, we propose a "ratchet" coupon financial accounting covenant. With a rise in the leverage ratio (or a fall in the Core Tier 1) the ratchet is triggered, automatically increasing the cost of debt and the return on equity of the firm. Both the concave nature of the equityholders' return on equity (at each ratchet trigger point there is a step down in the ROE), and the higher cost of capital once triggered (as suggested above) discourage equityholders from taking higher risk. We show that this type of covenants are effective when the firm's solvency is high, but loses its effectiveness as the firm's balance

sheet approaches the critical points (CoCo trigger or the PONV). Theoretically this is due to the quasi-concave nature of the indifference curves (the curve turns less concave, and eventually convex, at the low V_0 / high σ end); intuitively, near the critical point the allure of "gamble-for-ressurrection" negates the positive effect of the ratchet coupon covenant. Therefore we suggest the use of this type of covenant at the CoCo bond inception while the solvency is high. In a falling solvency scenario we propose a different type of covenants, specifically asset sweep and debt sweep covenants. In the former the asset is partially sold off to pay down some of the debt, while in the latter newly issued debt is used to repay existing debts. Both discourage (or prevent, in the debt sweep case) equityholders from piling on more debt to attempt "gamble-for-ressurrection". The mechanisms of both of these types of covenants are outlined in detail in the text.

Notwithstanding the implementation of covenants, the agency costs and moral hazard are not fully attenuated. Once the solvency has significantly fallen and moved towards the PONV, covenants are no longer effective. The higher cost of capital triggered by the covenant breach is not longer an economic driver for shareholders to reduce risk. Shareholders could then attempt to "gamble for resurrection" to exploit the agency costs from the DAPR.

Consequently, we suggest two radical ways to mitigate both the agency cost and moral hazard problems. The first is to improve the currently established CoCo structures. We argue here that the now commonly issued writedown/off CoCo Bail-in bonds, when triggered, lead to a large wealth transfer from bondholders to the equityholders and should not be implemented at all. On the other hand, the equity-conversion CoCos are equivalent to non-admissible debt-to-equity swap (NADES), which, compared with ordinary debt-to-equity swaps, favours equityholders by pre-setting the terms of conversion (in particular, the conversion price). We show here that a conversion price which is above the level expected for a bank in distress has an effect of partially offsetting the dilution effect of equity-conversion. Instead we suggest a *market-price equity conversion CoCo bonds*, which mirrors the dilution of an ordinary equity raise in a distressed situation. Contrary to the share price-linked CoCo trigger suggested by Sundaresan and Wang (2015) where the trigger is not based on solvency but on the level of share price, hence giving the market the discretion to force

the CoCo trigger, our proposal encourages equityholders to take preemptive actions as the solvency deteriorates and the share price becomes depressed. More specifically, should the market turn very negative on the share price for fundamental or speculative reason, with our proposal the equityholders will have the incentive to raise equity before the conversion price of the CoCo significantly dilutes them. The second more radical solution is to establish a contingent shareholder base called the *Contingent Equity Base (CEB)* that initially sits off-balance sheet. It will however replace the incumbent equityholders once the CoCo is triggered or the solvency falls below the PONV. While sitting off-balance sheet the CEB also acts as the contingent capital for a fee to “top up” the bank’s solvency ratios such as to fulfil the regulator’s requirement for CT1 and T1 ratios. As the bank builds-up its capital base towards these ratios, the contingent capital is wound down. As will be demonstrated, this proposal would finally remove the “gamble for resurrection” and other risk-taking incentives, and encourage the equityholders to undertake monitoring. Several options for the valuation of the CEB are discussed, with the cost of equity suggested as the most appropriate one.

This chapter is structured as follows. In Chapter 6.1 we suggest a practical way of dampening the risk of lurking agency costs by proposing financial and non-financial covenants in the CoCo bond indenture. In Chapter 6.2 we once again review the agency costs associated with both the writedown and equity-conversion CoCo Bail-in structures, and argue for the equity market-conversion CoCo bonds as an alternative. We also suggest a new Contingent Equity Base that would finally remove the agency costs and moral hazard problems associated with bank structure, and suggest a valuation for the CEB. Furthermore, we discuss the merits and the demerits of our proposals. Finally in Chapter 6.3, we give concluding remarks.

6.1 Covenants As a Monitoring Tool

We have established in Chapter 5 that the agency costs can, to a certain extent, be mitigated by rising required rate of return when riskier project plan is chosen. In practice this equates to the bondholders demanding higher cost of debt to compensate for their

monitoring cost. In this chapter we propose covenants within the CoCo indentures to implement this idea.

Covenants are regularly inserted in corporate bonds (especially from high yield issuers) to monitor more effectively the investment and financial policies of the company. Corporate covenants have successfully attenuated investment distortions and risk-taking incentives in the corporate bond market through higher monitoring and bond costs, reducing agency costs between equityholders and bondholders (see for example, Gamba and Triantis (2014)¹). In a similar manner we propose covenants in the CoCo indentures to promote financial and investment discipline in banks to curb risk-taking appetite.

We suggest *financial accounting covenants* with a “ratchet coupon” system whereby the CoCo bond coupon rate gradually increases as the fundamentals of the bank debilitate and the covenants are breached. The ratchet system is suggested as the empirical literature on corporate bond covenants (e.g. Bradley and Roberts (2004), Gamba and Triantis (2014)) tend to indicate that the conventional covenants are usually fixed at relatively low levels and fail to exert the necessary financial discipline on the company. Introducing a ratchet with different covenant levels enables the bondholders to monitor and control the bank’s risk-taking more effectively. With the rising risk-taking bondholders are compensated through a coupon increase that mirrors the increasing risk premium. Similarly through a comprehensive covenant ratchet that tallies the financial ratio with different coupon levels, the regulator can prevent equityholders from taking actions that would further extract wealth from bondholders as the solvency ratios head towards the CoCo trigger or the PONV. The covenant will exert discipline on managers and equityholders due to onerous coupon increases which will automatically dent equityholders’ returns. Our result in Proposition 5.16 suggests that this type of covenant based-discipline is more effective during times of stable solvency, away from the point of restructuring. Later, for covenants close to restructuring point we suggest different kind of covenants, namely *asset sweep* and *debt sweep covenants*.

¹They show how effective debt covenant restrictions can shift shareholders’ financing and investments towards value maximisation.

6.1.1 Ratchet Coupon Financial Accounting Covenants

Following empirical evidence (for example Bradley and Roberts (2004), Billet, King and Mauer (2007), Chava and Roberts (2008), Roberts and Sufi (2009), Gamba and Triantis (2014)) of covenants on corporate bonds, we suggest three candidates for the index for the ratchet trigger in our proposed financial accounting covenants:

- Fully loaded Core Tier 1 Ratio: $\frac{CT1}{RWA}$.
- Leverage Ratio: $\frac{Equity+AT1}{Assets}$, where AT1 is the Tier 1 CoCo.
- Interest Coverage / ADI² interest coverage: $\frac{ADI}{CoCo\ coupon\ payment}$.

Financial accounting covenants are suggested as it is difficult to use income statement based covenants due to the ongoing presence of exceptional and one-off items in the banks' profit and loss account. The choice of the CT1 ratio would be a natural one, as both the CoCo trigger and the coupon payments are then linked to the Core Tier 1 of the bank, allowing bondholders to evaluate the degree of headroom versus CoCo trigger and coupon suspension (on AT1s). The leverage ratio covenant would allow bondholders to monitor bank's indebtedness to restrict balance sheet expansion and constrain managers to constantly pursue equityholders friendly investments.³ The interest coverage covenant (to monitor the buffer on AT1s coupon payments) is a common covenant in corporate bonds to assess the ability of the company to service the coupons. These covenants would have to be calibrated to suit the nuances of each CoCo bond class. Specifically, CoCo T2s have a specific maturity and mandatory coupon payments, and hence the introduction of covenants and ratchets would be easier as these bonds are similar to unsecured corporate bonds. On the other hand CoCo AT1s are perpetual and their coupons payments are not mandatory,⁴ and so imposing a ratchet covenant structure on these may be more challenging.⁵

²Maximum Amount of Distributable Items linked to the holding company or the distance to coupon suspension on the Combined Buffer (minimum CT1 including all additional buffers).

³For example the sovereign bond "carry trade", as sovereign bonds are zero risk weighted asset.

⁴AT1 CoCo bond coupons can be partially or totally suspended if there is not enough Distributable Amounts within the equity (set by the MDA - Maximum Distributable Amount) or if the Combined Buffer (comprising the Countercyclical, Conservation and Systemic equity buffers) is breached.

⁵Moreover, if the capital ratios fall below the Basel III combined buffer (the buffer above the minimum capital ratio), the coupon payments can be reduced or even suspended. Furthermore, the indenture does not

We now describe the covenant's mechanism with a simple model using the leverage ratio. The value of the asset A_t at period $t \in \{0, 1\}$ is the sum of the equity E_t , the plain vanilla bond D_t and the T2 CoCo bond C_t ,

$$A_t = E_t + D_t + C_t. \quad (6.1)$$

The leverage ratio L_t at period t is then,⁶

$$L_t = \frac{E_t}{A_t}. \quad (6.2)$$

The costs of debt of the plain vanilla bond and the CoCo bond are r_D and r_C , respectively. The return on equity of the asset is $r_A > 0$. Then at the end of the period 0 the firm produces the EBIT of $r_A A_0$. Assuming zero tax rate the bank's net income is then,

$$n_0 = r_A A_0 - r_D D_0 - r_C C_0. \quad (6.3)$$

The bank's return on equity (ROE) is,

$$r_E = \frac{n_0}{E_0}. \quad (6.4)$$

We assume that this net income is added to capital in whole as retained earnings. The period 1 asset and the leverage are then given by (6.1) and (6.2) above with $D_1 = D_0$, $C_1 = C_0$ and

$$E_1 = E_0 + n_0 \text{ and } A_1 = A_0 + n_0. \quad (6.5)$$

This implies an increasing leverage ratio $L_1 = \frac{E_1}{A_1} > \frac{E_0}{A_0} = L_0$ for a profit-making bank with $n_0 > 0$, as $\frac{E_0 + n_0}{A_0 + n_0} > \frac{E_0}{A_0} \Leftrightarrow A_0 E_0 + n_0 A_0 > A_0 E_0 + n_0 E_0 \Leftrightarrow A_0 > E_0$.

Consider now a new risky investment I_0 at period 0 with an uncertain return r_I . The investment is funded by an increase in the plain vanilla bond issuance, $I_0 = D'_0 - D_0$.

contemplate any dividend stopper (CoCo bond coupons can be suspended whilst dividends are paid out) or pushers (dividends payments can be resumed whilst CoCo bond coupons can still be missed).

⁶The Basel III leverage ratio allows for the AT1 CoCo bond (effectively a deeply perpetual subordinated Tier 1 bond) to be included.

The funding cost is assumed unaffected at r_D despite the decrease in the leverage ratio to,

$$L'_0 = \frac{E_0}{A'_0} = \frac{E_0}{A_0 + I}. \quad (6.6)$$

The leverage ratio in period 1 is now,

$$L'_1 = \frac{E_0 + n_0 + (r_I - r_D) I}{A_0 + I + n_0 + (r_I - r_D) I} = \frac{E_1 + (r_I - r_D) I}{A_1 + I + (r_I - r_D) I}. \quad (6.7)$$

The covenant specifies the ratchet trigger leverage ratios and the corresponding CoCo bond coupon levels $\{f^i, r_C^i\}$, $i = 1, 2, \dots$, with $L_0 > f^1 > f^2 > \dots$ and $r_C < r_C^1 < r_C^2 < \dots$. Consider the first trigger level f^1 . This is breached when $L'_1 < f^1$, or

$$r_I < r_D - \frac{E_1 - (A_1 + I) f^1}{(1 - f^1) I} = r_I^1, \quad (6.8)$$

where r_I^i is the realized rate of return of the risky investment corresponding to the ratchet trigger rate f^i . Note where the right-hand side is positive this implies that the ratchet would be triggered even when the risky investment returns a positive rate. Similarly the second ratchet is triggered when,

$$r_I < r_D - \frac{E_1 - (r_C^1 - r_C) C_0 - [A_1 + I - (r_C^1 - r_C) C_0] f^2}{(1 - f^2) I}. \quad (6.9)$$

The equityholders' realized ROE depends on the ratchet trigger,

$$r'_E = \begin{cases} r_E + (r_I - r_D) \frac{I}{E_0}, & \text{if } r_I^1 < r_I \\ r_E + (r_I - r_D) \frac{I}{E_0} - (r_C^1 - r_C) \frac{C_0}{E_0}, & \text{if } r_I^2 < r_I \leq r_I^1 \\ r_E + (r_I - r_D) \frac{I}{E_0} - (r_C^2 - r_C) \frac{C_0}{E_0}, & \text{if } r_I^3 < r_I \leq r_I^2 \\ \vdots & \vdots \end{cases}. \quad (6.10)$$

Fig 6.1 depicts the effect of the ratchet coupon covenant on the equityholders' return. This financial accounting covenant then encourages lower risk-taking through two channels. Firstly, the step-down nature of the ROE as r_I falls introduces concavity in the return profile of the equityholders. In much the same way as the convexity in the equityholders'

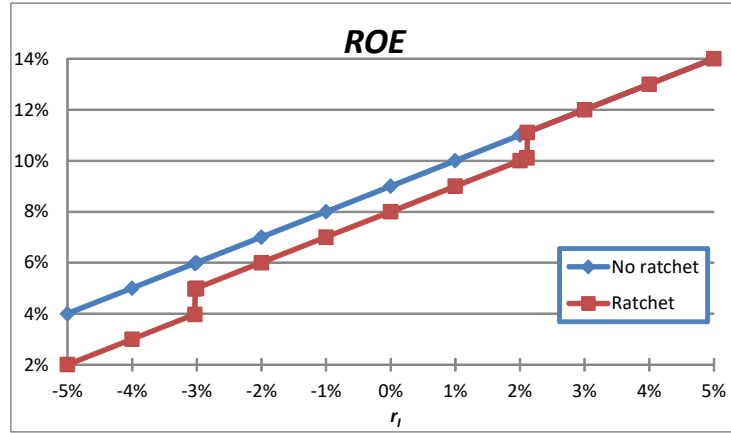


Figure 6.1: ROE vs r_I with Ratchet Coupon Covenant

payoff at Bail-out / Bail-in trigger points creates incentive for higher risk-taking (due to a long vega position), the concavity at the ratchet trigger points (i.e. a short vega position) discourages risk-taking. Secondly, once the ratchet is triggered the higher CoCo coupon means higher cost of debt for the bank, which leads to lower risk-taking being chosen as the equityholders' optimal choice as discussed in Proposition 5.15.

However, both of these two channels become less effective as the bank's balance sheet nears the PONV or the CoCo trigger. For the first channel this is because the concavity at the ratchet triggers are offset by the convexity at the CoCo trigger. For the second channel, we already saw in Proposition 5.16 that the convexity of the equityholders' indifference curve near the CoCo trigger point reduced its effectiveness. Intuitively, the appeal of "gamble-for-resurrection" or "looting" more than offsets the effectiveness of these covenants. We therefore suggest introducing these financial accounting covenants at the inception of CoCo bonds when, by assumption, the solvency ratios of the bank are healthy.

6.1.2 Asset Sweep / Debt Sweep Covenants

In a falling solvency scenario where risk-taking and "gamble-for-resurrection" incentives are high (as demonstrated in the previous chapter), we instead propose the following types of covenants:

- Asset Sweep Covenant
- Debt Sweep Covenant

Asset sweeps are common in private debt placements (see, for example, Bradley and Roberts (2004)). Once triggered, the bank is forced to sell assets to pay down debt, and thereby increasing the leverage ratio. This prevents equityholders from liquidating assets to receive a large dividend (i.e. “looting”) or take on new debt to finance a risky investment (“gamble-for-resurrection”), reducing the agency cost of Bail-in near the CoCo trigger point / PONV.⁷

Let now β be the proportion of the asset that has to be divested, post-risky investment A'_1 . We assume that the whole of this is used to pay down the debt, whereby the debt is reduced to $D'_1 - \beta A'_1$.⁸ The bank will seek to sell those assets in which it can materialize a capital gain, i.e. $b > 1$, where b is the ratio of the asset’s market value and its nominal value. The profit from this divestiture is therefore $(b - 1) \beta A'_1$, which is added to the bank’s capital as retained earnings. Consequently the equity is increased to $E'_1 + (b - 1) \beta A'_1$, while the final value of the asset is $(1 - \beta) A'_1 + (b - 1) \beta A'_1 = A'_1 + (b - 2) \beta A'_1$. Therefore the bank’s leverage ratio becomes,

$$L'_1 = \frac{E'_1 + (b - 1) \beta A'_1}{[1 + (b - 2) \beta] A'_1}. \quad (6.11)$$

When $b > 1$ this is greater than $\frac{E'_1}{A'_1}$, where the leverage ratio is bolstered by both a lower denominator (asset) and a higher numerator (equity).⁹ The trigger level $\frac{E'_1}{A'_1}$ and the divestiture ratio β are designed such that the leverage ratio is likely to be restored to a minimum

⁷This type of covenant could dissuade shareholders from pursuing asset divestitures, as the proceeds will accrue to bondholders. However, if the market price of the CoCo has fallen to a level where a buy back could lead to a capital gain (we suspect the price of the CoCo could drop by 30%-50% if these covenants are triggered), then shareholders will benefit from a lower leverage ratio, via lower assets (less debt) and higher equity (capital gain).

⁸Going forward all unsecured debt will be loss absorbing (including senior) but the regulator is targeting a minimum loss absorbing capacity (TLAC). Since the regulator would never allow a CoCo to be repaid nor any loss absorbing debt that makes up the TLAC, we argue that the asset sweep should work for any non-TLAC debt (both secured and unsecured).

⁹ L'_1 is increased for all values of $b > 1$ as $\frac{E'_1 + (b-1)\beta A'_1}{[1+(b-2)\beta]A'_1} > \frac{E'_1}{A'_1} \Leftrightarrow A'_1 E'_1 + (b-1)\beta (A'_1)^2 > [1 + (b-2)\beta] A'_1 E'_1 \Leftrightarrow (b-1) A'_1 > (b-2) E'_1$, which is true as $b-1 > b-2$ and $A'_1 > E'_1$.

level required by the regulator, though this will clearly depend on the capital gain ratio b . However in the case that the asset sale fails to restore the leverage ratio to the required level, the regulator can impose further non-core asset sales and dividend / CoCo bond payouts¹⁰ cancellations to bolster solvency and reinstate the leverage ratio back to the compulsory level.

The *debt sweep* covenant resembles the asset sweep covenant, however the proceeds from newly issued debt is used to repay existing debt when the leverage ratio has fallen below the last ratchet (or any other financial covenant) trigger level. This sets a floor in the bank's leverage ratio, curbing equityholders' appetite for leveraging up as the bank's solvency deteriorates.

We believe through a combination of these three types of covenants the agency costs can be contained. Financial covenants are useful to keep risk and leverage appetite down (especially in a low profitability environment) from the bond inception, enabling bondholders to monitor the banks and incorporate the increasing risk premium in the market price of the bonds as soon as the risk profile of the bank creeps up. We have proposed a ratchet coupon structure which we believe is an effective way of doing this. Both asset and debt sweep covenants contribute to the diminishing of the appetite for debt when risky investment opportunities become appealing for the bank, as they alleviate the incentives of the banks to issue new debt to extract wealth from existing bondholders. These two covenants should be triggered when the solvency ratios are decreasing and financial covenants are no longer effective near the PONV or the CoCo trigger point.

6.2 Removing moral hazard: Market Price Equity Conversion CoCo and CEB

As aforementioned, covenants inserted in CoCo and bail-in-able debt can turn out to be very effective when solvency ratios are high. However, as the solvency deteriorates, the wealth transfer and value destruction agency costs arise and set in the capital structure.

¹⁰The bond indenture should contemplate this event, especially in AT1 CoCo bonds.

Covenants are no longer able to dissuade shareholders from pursuing risky investments and potentially "gamble for resurrection".

In this Chapter we suggest two further ways to mitigate both the agency cost and moral hazard problems. The first is to improve the currently established CoCo structures. We argue here that the now commonly issued writedown/off CoCo Bail-in bonds, when triggered, lead to a large wealth transfer from bondholders to the equityholders and should not be implemented at all. On the other hand, the equity-conversion CoCos are equivalent to non-admissible debt-to-equity swap (NADES), which, compared with ordinary debt-to-equity swaps, favours equityholders by pre-setting the terms of conversion (in particular, the conversion price). We show here that a conversion price which is above the level expected for a bank in distress has an effect of partially offsetting the dilution effect of equity-conversion. Instead we suggest a *market-price equity conversion CoCo bonds*, which mirrors the dilution of an ordinary equity raise in a distressed situation. Contrary to the share price-linked CoCo trigger suggested by Sundaresan and Wang (2015) where the trigger is not based on solvency but on the level of share price, hence giving the market the discretion to force the CoCo trigger, our proposal encourages equityholders to take preemptive actions as the solvency deteriorates and the share price becomes depressed. More specifically, should the market turn very negative on the share price for fundamental or speculative reason, with our proposal the equityholders will have the incentive to raise equity before the conversion price of the CoCo significantly dilutes them. The second more radical solution is to establish a contingent shareholder base called the *Contingent Equity Base (CEB)* that initially sits off-balance sheet. It will however replace the incumbent equityholders once the CoCo is triggered or the solvency falls below the PONV. While sitting off-balance sheet the CEB also acts as the contingent capital for a fee to "top up" the bank's solvency ratios such as to fulfil the regulator's requirement for CT1 and T1 ratios. As the bank builds-up its capital base towards these ratios, the contingent capital is wound down. As will be demonstrated, this proposal would finally remove the "gamble for resurrection" and other risk-taking incentives, and encourage the equityholders to undertake monitoring. Several options for the valuation of the CEB are discussed, with the cost of equity suggested as the most appropriate one.

6.2.1 Market-price Equity-conversion CoCo Bail-in

Currently there exist the following two types of CoCo Bail-in bonds:

1. Writedown/off bonds, where the bond principal is written-down or off on a temporary or permanent basis. Here we focus on a structure where the entire bond is written-down at the trigger, where any remaining principal net of the loss is converted into an item within the equity base as Contingent Capital Reserve (CCR) to account for any potential future losses. The ownership of this CCR is here assumed to be transferred to the equityholders.
2. Equity-conversion bonds where the bonds are converted to equity at a preset price.

We have already argued in this thesis that both formats accentuate the wealth transfer problem associated with Bail-in structures. Consider first writedown/off bonds. With these, the CoCo bondholders are precluded from any potential future equity upside while providing the guarantee on the downside. For example, with a one-off loss (e.g. a rogue trader causing a multi-billion loss) that triggers the CoCos, the bondholders are erased from the balance sheet altogether, while the share price would gradually recover once investors are reassured that the loss is a one-off and would not affect the bank's normalised¹¹ ROE. Alternatively, under a falling solvency scenario, the structure encourages free-riding behaviours of the equityholders, and in extreme cases to “gamble-to-resurrect”. To see this more formally, consider a bank with an initial asset value of V_0 . The bank is funded by equity and bond borrowing. The bonds consist of vanilla bonds with a total face value of F_B and a CoCo Bail-in bond with face value F_W . Hence $F = F_B + F_W$. This set up is the same as in previous chapters. The equityholders' position is then $E_E = V_0 - F$. The conversion is triggered when the CT1 ratio $\frac{V_T - F}{V_T}$ falls below τ , which occurs for bank values of $V_T \leq \frac{F}{1-\tau}$. After the trigger the regulator moreover insists on a minimum required CT1 ratio of \underline{E} , which, for very low V , is assumed to be achieved by a forced one-to-one conversion of the vanilla bond.¹² The details of the payoffs to and the losses of the bondholders and

¹¹Adjusted for cyclical variations or one-off effects.

¹²“Under BRRD [Banking Recovery and Resolution Directive], senior unsecured bank debt will become ‘bail-in-able’ during times of distress from 2016, although some countries have fast-tracked the legislation.” *The Financial Times*, “Scene changes on risks and rewards of bank debt”, 10th September 2015.

the equityholders for different outcomes of V_T are given in Chapter 5.1.6. By construction, the writedown bondholders lose everything once the Bail-in is triggered, and therefore their payoff is given in [5.27] as,

$$D_W^{WOBI} = F_w \chi_{V_T \geq \frac{F}{1-\tau}} \quad (6.12)$$

where $\chi_{V_T \geq \frac{F}{1-\tau}} = \begin{cases} 1 & , \text{ if } V_T \geq \frac{F}{1-\tau} \\ 0 & , \text{ if } V_T < \frac{F}{1-\tau} \end{cases}$ is again an indicator function. The equityholders' position has a floor at the trigger level which is also boosted by the newly converted CCR, the value of which is given in (5.26) as,

$$E_E^{WOBI} + E_{CCR}^{WOBI} = V_T - F + F_W \chi_{V_T \leq \frac{F}{1-\tau}} + (1 - \tau) \max \left[\frac{F_B}{1 - \tau} - V_T, 0 \right]. \quad (6.13)$$

This can be rewritten as,

$$E_E^{WOBI} + E_{CCR}^{WOBI} = V_T - F + \max [F - (1 - \tau) V_T, F_W] \chi_{V_T \leq \frac{F}{1-\tau}}. \quad (6.14)$$

We term the second term of (6.14) the *gains from trigger*. This is clearly positive and take a value of at least F_W , giving the equityholders a perverse incentive to trigger.

Next consider equity-conversion bonds where the CoCo investors end up with a share of the equity capital. This results in a dilution effect for the original equityholders. However, as analysed in detail in Chapter 5.4 the structure is equivalent to a Non-Admissible Debt-to-Equity Swap (NADES), where, as opposed to traditional corporate restructuring proceedings, bondholders are unable to participate in the negotiations of the debt-to-equity exchange.¹³ We argue below that when the conversion price is set at a level higher than the book value at the time of conversion, one of the consequences of NADES is that it offsets some of the dilution effect of conversion. Consider again our example bank, however with an equity-conversion CoCo bond with face value F_C , i.e. $F = F_B + F_C$. The conversion is again triggered for bank values $V_T \leq \frac{F}{1-\tau}$, however this time the CoCo bond is partially converted to equity in such a way that the bank's CT1 ratio is restored to a minimum

¹³In contrast, in an admissible debt-to-equity swap, the bondholders with their bargaining power, are able to set favourable bail-out terms including the conversion price.

required level of \underline{E} . Consider for example a bank valued initially at $V_0 = 110$, with $F_B = 80$ and $F_C = 10$. Then the equityholders' initial position is $V_0 - (F_B + F_C) = 20$. Let also $\tau = 7\%$ and $\underline{E} = 10\%$. Then the CoCo conversion is triggered for V_T below $\frac{F}{1-\tau} = 96.77$. Take the example of $V_T = 95$. Then the bank has incurred a loss of 15. The equityholders take the initial loss up to the trigger level, $E_E = \tau V_T = 95 \times 0.07 = 6.65$, which is a loss of $L_E = 20 - 6.65 = 13.35$. The CoCo bond is partially converted so that they end up with an equity position that makes up the shortfall between the minimum required level $\underline{E}V_T$ and $E_E = \tau V_T$, i.e. $E_C = \underline{E}V_T - \tau V_T = (0.10 - 0.07) \times 95 = 2.85$. The vanilla and CoCo bondholders together hold $(1 - \underline{E}) V_T = 0.9 \times 95 = 85.5$, so the CoCo bondholders' remaining bond position is $D_C = 85.5 - F_B = 85.5 - 80 = 5.5$. This means that the CoCo bondholders' total position is $D_C + E_C = 5.5 + 2.85 = 8.35$, i.e. they bear the loss of $L_C = 10 - 8.35 = 1.65$. This is the remaining loss after the equityholders' share of 13.35.

Consider now the dilution effect of this. For demonstration, first assume that the market price-to-book ratio is 1 throughout, and that the conversion takes place at the book value at the time of trigger. This means that the theoretical ex-rights price (TERP) is the same as the book value pre-conversion. Then the original equityholders' position is now reduced to $\frac{E_E}{E_E + E_C} = \frac{6.65}{6.65 + 2.85} = 70\%$, i.e. they are diluted by 30%. More generally, with $E_E = \tau V_T$ and $E_E + E_C = \underline{E}V_T$, the equityholders' dilution is restricted to $\frac{E - \tau}{\underline{E}}$. However in reality, the equity-conversion CoCo bonds are converted into equity at a pre-specified fixed conversion price. Let this conversion price be ρ , if the number of shares for the original equityholders is N_E , then,

Proposition 6.1 *The dilution is less than $\frac{E - \tau}{\underline{E}}$ for all triggers if*

$$\rho > \frac{F}{N_E} \frac{\tau}{1 - \tau}. \quad (6.15)$$

Proof. As the CoCo bondholders receive equity of $E_C = (\underline{E} - \tau) V_T$ upon conversion at the preset price of ρ , they receive N_C shares, where

$$N_C = \frac{(\underline{E} - \tau) V_T}{\rho}. \quad (6.16)$$

Then the proportion of the equity held by the original equityholders post-conversion is $\frac{N_E}{N_E+N_C}$, or equivalently, their holding is diluted by $1 - \frac{N_E}{N_E+N_C} = \frac{N_C}{N_E+N_C}$, which when substituting for N_C is,

$$\text{dilution} = \frac{(\underline{E} - \tau) V_T}{\rho N_E + (\underline{E} - \tau) V_T}. \quad (6.17)$$

This is less than $\frac{\underline{E}-\tau}{\underline{E}}$ when $\rho > \frac{\tau V_T}{N_E}$. Note that this is when the CoCo bondholders are forced to convert into equity at a price higher than the equity book value just prior to the trigger, $\frac{E_E}{N_E} = \frac{\tau V_T}{N_E}$. By manipulation this happens for asset values $V_T < \frac{\rho N_E}{\tau}$. As trigger occurs only for $V_T \leq \frac{F}{1-\tau}$, a sufficient condition for this to be true at all conversion is that $\frac{F}{1-\tau} < \frac{\rho N_E}{\tau}$, which is equivalent to (6.15). ■

This means that, when condition (6.15) is satisfied, in all cases of preset fixed price conversion the conversion price has the effect of partially offsetting the dilution effect of Bail-in. Furthermore, this is still the case even if (6.15) is not satisfied for sufficiently low value of V_T , more specifically, when $V_T < \frac{\rho N_E}{\tau}$. In Chapter 5.4, the fixed-price equity-conversion structure was analysed to be equivalent to a Non-Admissible Debt-to-Equity Swap (NADES), as opposed to a traditional admissible debt-to-equity swap where the bondholders utilize fully their bargaining power to set the optimal (from the bondholders' point of view) Bail-out terms including the conversion price. Proposition 6.1 is one of the consequences of the structure being a NADES.

In view of the above, we make two suggestions for dampening the agency costs and the moral hazard incentives. The first is to rule out writedown/off structures altogether, removing the extreme incentive for risk-taking associated with the structure. The second is the replacement of the fixed-price equity-conversion CoCo bonds with market-price equity-conversion CoCo bonds. More specifically, we propose a CoCo that converts at the existing market share price plus a 30% discount¹⁴. We show below that this effectively removes the NADES effect. With this proposal the CoCo bonds are exchanged at a fair price that mirrors the economics of an ordinary equity raise of a distressed bank, where new shares are issued at the prevailing price plus a significant discount, reducing the perverse incentive

¹⁴Distressed equity raising of ailing banks and companies usually come with 40%-50% discount to the prevailing share price.

of gambling with the bondholders' wealth.

Let now then the conversion price be $\rho(V_T)$, which depends on the firm's value V_T . This is proposed to be the market share price with a discount of δ ,

$$\rho(V_t) = \frac{\lambda \tau V_T}{N_E} (1 - \delta). \quad (6.18)$$

where λ is the market price-to-book ratio. As the firm's status deteriorates this conversion price falls via three channels: lower V_T , lower price-to-book ratio λ and higher discount on share price δ . The number of shares received by the CoCo bondholders is now,

$$N_C = \frac{(\underline{E} - \tau) V_T}{\rho(V_t)} = \frac{N_E (\underline{E} - \tau)}{\lambda \tau (1 - \delta)}. \quad (6.19)$$

For constant λ and δ , this is equivalent to a fixed-number conversion. Otherwise N_C is increasing for a decreasing λ or an increasing δ . The dilution is now,

$$\text{dilution} = \frac{N_C}{N_E + N_C} = \frac{\underline{E} - \tau}{\lambda \tau (1 - \delta) + (\underline{E} - \tau)}. \quad (6.20)$$

Then,

Proposition 6.2 *The dilution is more than $\frac{\underline{E} - \tau}{\underline{E}}$ if*

$$\lambda (1 - \delta) < 1. \quad (6.21)$$

Proof. Follows immediately from $\frac{\underline{E} - \tau}{\lambda \tau (1 - \delta) + (\underline{E} - \tau)} > \frac{\underline{E} - \tau}{\underline{E}}$. ■

In summary, there are two channels for equity dilution with the CoCo equity-conversion trigger: one, the capital injection due to the equity conversion, where the original equityholders' holding is reduced to $\frac{\tau}{\underline{E}}$, and the other, where the equity conversion happens at a favorable price for the CoCo bondholders, increasing the proportion that they hold to above $\frac{\underline{E} - \tau}{\underline{E}}$. The condition for the second dilution to be positive is given by Proposition (6.2), which is satisfied if the price-to-book ratio falls to below 1 or if there is a non-zero discount in the conversion price. This is demonstrated in the numerical example below, where $N_E = 10$ million, $\lambda = 1$ and $\delta = 30\%$. As before, $F_B = 80$, $F_C = 10$ and $\tau = 7\%$ and

the trigger occurs at 96.77. Below 88.89, the forced-writedown of the vanilla bond kicks in to maintain the minimum equity capital ratio $\underline{E} = 10\%$. As seen the dilution is lower than $\frac{E-\tau}{\underline{E}} = 30\%$ for the fixed-price conversion CoCo, while it is higher for the market-price conversion:

V_T	80.0	85.0	88.89	90.0	95.0	96.77	100.0
Market share price $\frac{E_E}{N_E}$	0.28	0.30	0.31	0.32	0.33	0.34	0.50
Fixed conversion price ρ	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Fixed-price conversion N_C (m)	4.00	4.25	4.44	4.50	4.75	4.84	0
Dilution	16.7%	17.5%	18.2%	18.4%	19.2%	19.5%	0%
Market price conversion price $\rho(V_T)$	0.20	0.21	0.22	0.22	0.23	0.24	0.35
Market-price conversion N_C (m)	12.24	12.24	12.24	12.24	12.24	12.24	0
Dilution	38.0%	38.0%	38.0%	38.0%	38.0%	38.0%	0%

The payoffs and losses for the general case is demonstrated in Appendix 6.4.1. In particular the payoff to the original equityholders is given by,

$$E_E = (V_T - F) + \left[F - \frac{\lambda\tau(1-\delta)(1-\underline{E}) + (\underline{E} - \tau)}{\lambda\tau(1-\delta) + (\underline{E} - \tau)} V_t \right] \chi_{V_T \leq \frac{F}{1-\tau}}. \quad (6.22)$$

Again the second term is the gain from trigger. Then,

Proposition 6.3 *There is a range of V_T just below the trigger point for which the gain from trigger is negative if $\lambda(1-\delta) < 1$.*

Proof. The gain from trigger in (6.22) is negative for the following values of V_T ,

$$\frac{\lambda\tau(1-\delta) + (\underline{E} - \tau)}{\lambda\tau(1-\delta)(1-\underline{E}) + (\underline{E} - \tau)} F < V_t \leq \frac{F}{1-\tau}. \quad (6.23)$$

This is not an empty set if,

$$\frac{\lambda\tau(1-\delta) + (\underline{E} - \tau)}{\lambda\tau(1-\delta)(1-\underline{E}) + (\underline{E} - \tau)} < \frac{1}{1-\tau} \Leftrightarrow \lambda(1-\delta) < 1. \quad (6.24)$$

■

This means that with our proposed market-price equity-conversion CoCo bond, the equityholders are worse off just below the trigger point than just above it as long as the

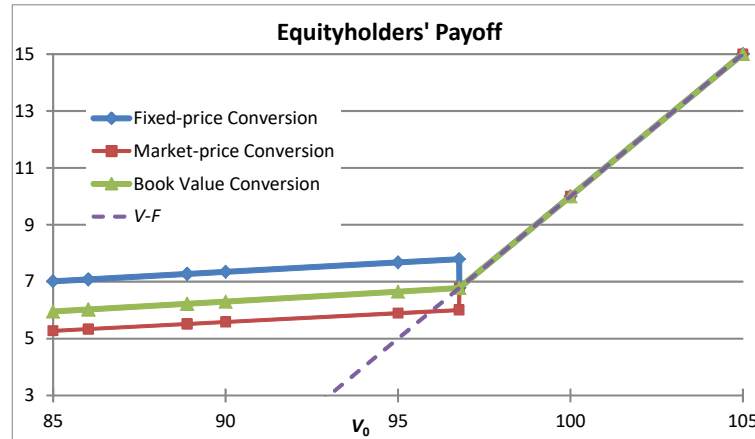


Figure 6.2: Equityholders' Payoffs

condition in Proposition 6.3 is satisfied, removing the “gamble-for-resurrection” incentive. Fig 6.2 demonstrates the positive and negative gains from trigger at the trigger point under fixed-price and market-price equity-conversion CoCo Bail-ins. The negative gains from trigger is indicated by the payoff line below the dashed $\max[V_T - F, 0]$ line.

Finally, we justify the adoption of discount $\delta > 0$ to the conversion price. There is already a vast literature that touches upon the reasons of the usual discount in equity offerings. These include:

1. *Signalling effect.* This arises from the asymmetric information where the managers hold more information than the investors. The market participants assume that when a company issues shares, the management believes that the shares are overpriced, while when they use internal resources, then the management believes that the shares are underpriced. Therefore any equity raise warrants a discount to compensate investors from the asserted overpricing. The same could be said between the current equityholders and the potential new investors, where the higher the internal support from equityholders, the better the signalling effect to the market.
2. *Transaction costs.* When a company decides to issue shares rather than using internal funds, it incurs issuance costs that investors incorporate as a discount to the share price (see for example Williamson (2002)).

3. *Modigliani-Miller Proposition 1* (MMP1): The well-known theory refers to the value of the levered company being equal to the value of the unlevered bank plus the tax shield of the debt. Consequently, should the company intend to use the proceeds of the equity raising to lower the debt, the company value should drop (by the value of the tax shield relinquishment) that could warrant a discount.

All of these reasons also apply to our CoCo trigger situations.

6.2.2 The Contingent Equity Base

The above proposal does not fully remove the risk-taking incentive from equityholders as solvency moves closer to the point of non-viability. Take a scenario where solvency is rapidly deteriorating and the equityholders do not want to (or cannot) issue equity. The CoCo Bail-in will then be triggered. Since equityholders know that contingent capital will be issued (even at distressed levels owing to our first proposal), which rescues the equityholders in a going-concern scenario (as opposed to facing a gone-concern liquidation), there remains an incentive to “loot” or “gamble-for-resurrection”. As such, the moral hazard does not disappear entirely as long as the equityholders do not face full dilution on a going-concern basis. Full dilution of equityholders would be the only way to restore the absolute priority rule (APR). What we propose in this Chapter is not for the equity to be written-off, but for the incumbent equityholders to be fully diluted. This revolutionary proposal would finally remove the intrinsic moral hazard of the banking industry.

We propose that banks should have an ongoing Contingent Equity Base (CEB) formed by a new equityholders base. The CEB will have a dual role:

- The CEB will take over the bank once the bank solvency falls below the PONV (whose threshold could be either the CoCo trigger or the level set by the regulator).
- The CEB will sit off-balance sheet for a fee as a “top-up” contingent line for the bank to make up the short-fall in their CT1 and T1 ratios.

The first of these roles means that once the solvency falls below the PONV, the incumbent equityholders are replaced by the new shareholder base and lose all their remaining equity holdings. In a falling solvency scenario, it would then be in the equityholders’

interest to raise equity (instead of gambling with bondholders money) to preserve their equity investment. This mirrors the traditional equity expropriation by the state, a la Bankia in 2012 or SNS in 2013. The main difference is that this proposal relies on private money instead of public resources.

More specifically the new recapitalization mechanism works as follows:

1. Initially a CEB is set up by equity investors with in-depth knowledge and expertise in the banking industry who are able to assess the risk and rewards of such commitment. This CEB will sit “idle” outside the bank’s balance sheet until the rescue is triggered.
2. The bank should have, at all times, as much CoCo/bail in able bonds as necessary to restore the bank’s solvency from the PONV/CoCo trigger to the level set by the regulator (perhaps $10 - 10.5\%$ CT1). These CoCo bonds are marked to market so that the regulator (and the bank and investors) know realistically how much equity will be created upon CoCo trigger. Furthermore, the bank is required to meet a minimum T1 ratio (e.g. 14%). Until these ratios are reached, the CEB will commit equity of their own as a contingent line, which will make up the difference between the minimum required T1 ratio and the existing ratio. The CEB will charge a fee for this contingent equity.
3. As the CoCo bonds and/or equity are raised to meet the capital requirements, the CEB is withdrawn accordingly. Once the capital requirements are fulfilled, the CEB providers recover their entire equity investment however they remain contingent future equityholders. Essentially the CEB line plays the role of an “equity revolving facility” where, if solvency drops, there is always contingent equity underpinning the bank’s balance sheet.
4. Once the CoCo Bail-in is triggered or the solvency falls below the PONV, the incumbent equityholders are replaced by the CEB providers and lose their entire investment. The CEB providers become the new equityholders. The existing CoCo bonds convert as proposed in Chapter 6.2.1, recapitalizing the bank to reach the minimum CT1.

5. After a CEB take over a new CEB is set-up. The CEB will set aside equity until the bank reaches its compulsory T1 ratio.
6. The CEB providers cannot be at any time equityholders of the bank before the restructuring happens. Thus, they are precluded from trading the shares of this bank. This has a two-fold objective: to minimize the risk of share price speculation, and to ensure that a new equity investor base replaces the old (failed) equityholders.
7. Should the CoCo Bail-in be triggered while CEB equity line is still active (i.e. the bank is still building capital to cancel the CEB equity line), the CEB converts at the same price as the CoCo. This ensures the capitalization of the bank at all times even if the bank has not fulfilled his compulsory solvency ratios.

We illustrate the process in the following example, depicted in Fig 6.3. The regulator imposes a minimum capital ratios of $\underline{E} = 10\%$ and $T = 14\%$ for CT1 and T1, respectively, and the CoCo trigger is $\tau = 7\%$.

Case 1 The initial state. The firm's asset value $V_0 = 110$ is funded by $F_B = 80$ of vanilla bonds and $F_C = 10$ of equity-conversion CoCo bond, with the equityholders holding $E_E = 20$ of equity capital. Then the CT1 and T1 ratios are 18.2% and 27.3% respectively, above the required ratios.

Case 2 The asset value falls to $V_T = 95$, incurring a loss of 15 for the bank. With $\tau V_T = 0.07 \times 95 = 6.65$, the incumbent equityholders bear an initial loss of $20 - 6.65 = 13.35$. This leaves a further loss of $15 - 13.35 = 1.65$, and therefore the CoCo Bail-in is triggered. As with the traditional equity-conversion CoCo Bail-in, the CoCo bond is partially converted such that the CT1 is restore to $\underline{E}V_T = 0.1 \times 95 = 9.5$, i.e. they receive equity of $E_C = 9.5 - 6.65 = 2.85$. This leaves the CoCo bond worth $D_C = (1 - \underline{E})V_T - F_B = 0.9 \times 95 - 80 = 5.5$. This means that $10 - 5.5 = 4.5$ of the CoCo bond has converted into $E_C = 2.85$ of equity, implying a loss for the CoCo bondholders of $L_C = 4.5 - 2.85 = 1.65$, which is exactly the remaining loss. The difference with the traditional Bail-in is that here the CEB replaces the original equity, resulting in

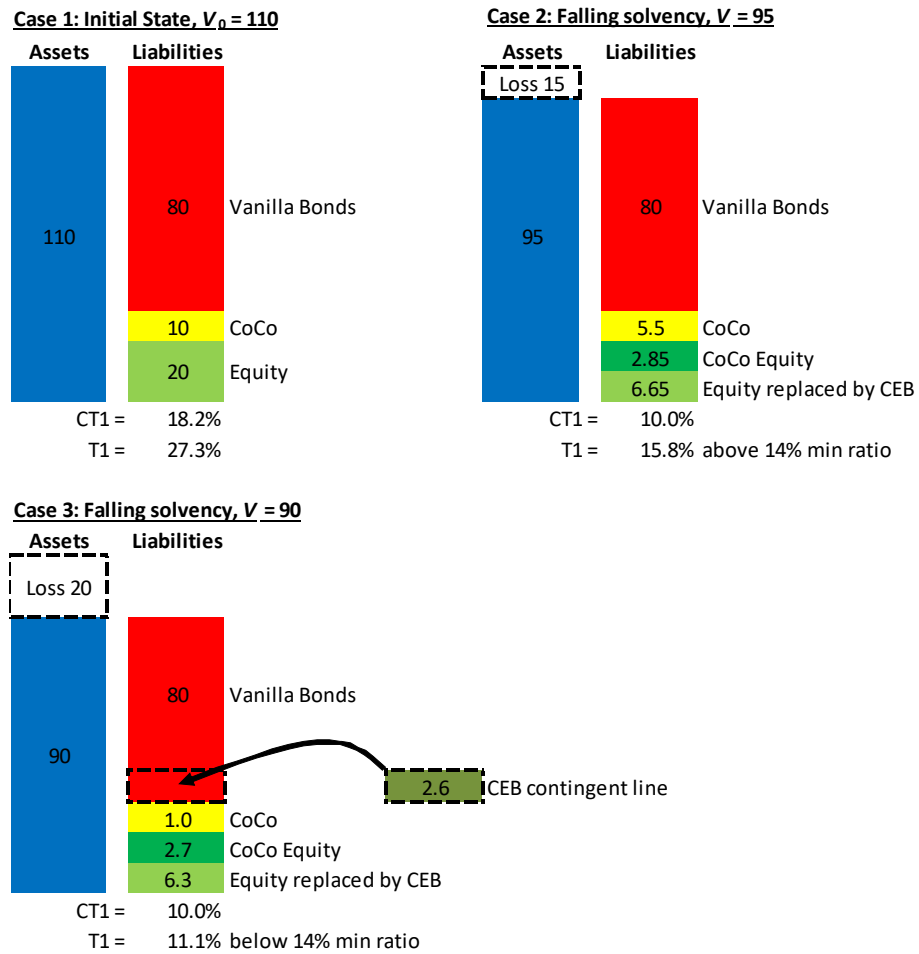


Figure 6.3: Falling Solvency Cases under CEB

$E_E = 0$ and $E_{CEB} = 6.65$. In this case the T1 ratio is $(5.5 + 2.85 + 6.65) / 95 = 15.8\%$, above the required ratio of 14%.

Case 3 The asset value falls to $V_T = 90$, incurring a loss of 20 for the bank. Analogously with Case 2, CEB providers expropriate the incumbent equityholders and receive $E_{CEB} = 0.07 \times 90 = 6.3$. The original equityholders lose $L_E = 20 - 6.3 = 13.7$, with the remaining loss of 6.3 being borne by the CoCo bondholders. Their resulting position is $E_C = (0.1 - 0.07) \times 90 = 2.7$ of equity and $D_C = 0.9 \times 90 - 80 = 1$ of remaining CoCo bond. Furthermore in this case, the T1 ratio of $(1 + 2.7 + 6.3) / 90 = 11.1\%$ is now below $T = 14\%$, so a CEB contingent line of $E_{T_1} = (0.14 - 0.111) \times 90 = 2.6$ is set-up for a fee off-balance sheet to top-up the ratio. This remains until the bank builds up its T1 capital to T .

Further cases of numerical examples are given in Appendix 6.4.2, as well as more general payoffs to, and losses of, the bondholders and the equityholders for different outcomes of V . In particular, the payoff for the original equityholders is summarized as,

$$E_E = (V_T - F) \chi_{V > \frac{F}{1-\tau}} \quad (6.25)$$

The comparison of the equityholders' payoffs between the ordinary equity-conversion and the CEB conversion is demonstrated in Fig.6.4. The gains from trigger is clearly negative, eliminating any incentive to gamble for resurrection round the trigger point.

CEB valuation

Our proposal suggests that the CEB commits a contingent equity line until the T1 ratio (CT1 plus CoCos) is achieved. This will guarantee the necessary capitalization at all times as already discussed. Until the solvency ratios are met and the CEB line is cancelled, the bank pays the CEB a fee for the outstanding equity line. This will encourage the bank to build-up capital on its own or issue more CoCo bonds. We discuss here what the level of this fee should be, or in other words, what the correct equity valuation is for the CEB line.

There is no straightforward measure as all equity valuation has its merits and

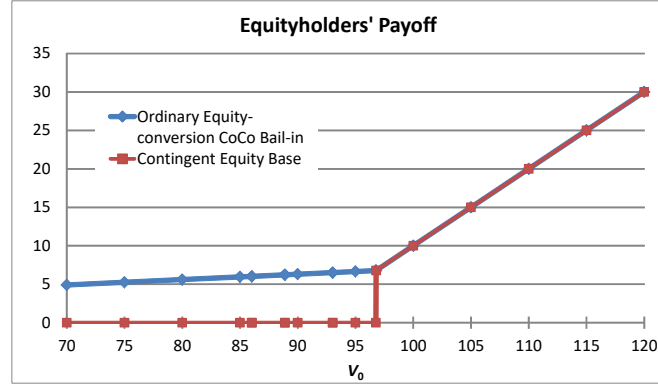


Figure 6.4: Equityholders' payoffs for ordinary equity conversion and CEB conversion

shortcomings. Accountancy based measures such as ROE and dividends yield are objective. However the valuation becomes challenging if the bank is loss making or not paying dividends and consequently the normalised earnings or dividends would have to be estimated.

We instead suggest using the Cost of Equity (COE) of the bank to set the fee charged by the CEB. This is because setting a fee lower than the bank's COE would mean that the bank can earn a higher return on capital elsewhere, discouraging them to build-up capital to cancel the CEB line. To calculate the COE is not a clear-cut exercise either as it entails its own difficulties. We suggest two ways to estimate the COE:

1. *Market data based:* Appendix 6.4.3 demonstrates that the price-to-book ratio (P/B) is given by,¹⁵

$$P/B = \left(\frac{ROE - g}{COE - g} \right) (1 + g), \quad (6.26)$$

where g is the bank's growth rate. Then the implied COE can be estimated by using the normalised ROE, g (can use nominal growth of the country where the bank has its main operations) and the current P/B ratio. However there are two important weaknesses of using this method:

¹⁵Damodaran on <http://people.stern.nyu.edu/adamodar/pdfiles/pbv.pdf> has $P/B = \frac{ROE - g}{COE - g}$ by assuming that "the return on equity is based upon expected earnings in the next time period". This removes the $(1 + g)$ factor from (6.26). See Appendix 6.4.3 for further discussion.

- P/B does not take into consideration the balance sheet risk of the bank (though this may be reflected through COE¹⁶).
- Using market values is sensitive to market manipulation and would make the CEB price market driven.

2. *CAPM*: Though the limitations are well known, CAPM is used by both practitioners and academics to calculate the WACC of companies and banks by,

$$COE = RFA + Beta \times ERP, \quad (6.27)$$

where *RFA* is the risk free asset return and *ERP* is the equity risk premium. *RFA* can be estimated, for example, using the nominal yield of the 10 year sovereign bond where the bank has its main operations. For *Beta*, one possibility is to use the two year adjusted beta of the bank relative to the equity market where the bank has its main operations. The ERP is the most sensitive and critical parameter within the CAPM COE and it has been thoroughly scrutinized by both the practitioner and academic world. There is no standard method to estimate it. In Appendix 6.4.4, we show an example of the estimated UK ERP according to the UK utility regulator Ofcom (Fig 6.12), and the difference between the historical ERP between UK and the World taken from Dimson (2004) (Fig 6.13). Given these, we conclude that 4% – 6% would be a plausible range.

Fig 6.5 demonstrates the estimated COEs of the 14 largest banks of the European Union as of 30 January 2015, with the average CAPM COE of 7.9% (using ERP = 6%) and the market implied COE of 9.5% (using $g = 2\%$). Similarly, with the range 4 – 6% for ERP, the CEB equityholders should earn a fee in the range 5.6% – 8% on average for our sample of banks, as calculated in Fig 6.6.

¹⁶The COE can be estimated by CAPM, as described above, reflecting the financial leverage of the bank in its equity beta:

$$\beta_{equity} = \beta_{asset} + \frac{D}{E} (\beta_{asset} - \beta_{debt}).$$

	BARCLAYS	HSBC	LLOYDS	RES	STANDARD CHARTERED	COMMERZ BANK	DB	BBVA	SANTANDER	INTESA	UNICREDIT	BNP	BPCE	CREDIT AGRICOLE	SOCIETE GENERALE	Average
RFA	1.4%	1.4%	1.4%	1.4%	1.4%	0.3%	0.3%	1.5%	1.5%	1.6%	1.6%	0.6%	0.6%	0.6%	0.6%	1.1%
Beta	1.2x	1.0x	1.0x	1.3x	1.0x	1.0x	1.1x	1.2x	1.1x	1.2x	1.3x	1.2x	1.1x	1.3x	1.4x	1.1x
ERP	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6.0%
P/B	0.6x	0.6x	1.1x	0.7x	0.4x	0.4x	0.5x	1.0x	0.9x	0.9x	0.6x	0.6x	0.5x	0.5x	0.5x	0.7x
2015 ROE	6.9%	9.2%	12.1%	6.0%	8.8%	3.8%	5.1%	7.5%	8.2%	6.4%	5.4%	8.1%	7.0%	6.8%	6.8%	7.2%
CAPM COE	8.6%	7.4%	7.4%	9.2%	7.4%	6.3%	6.9%	8.7%	8.1%	8.8%	9.4%	7.8%	7.2%	8.4%	9.0%	7.9%
Implied COE at g=2%	10.3%	11.3%	10.9%	7.9%	12.0%	6.1%	7.9%	7.7%	8.8%	6.8%	8.1%	11.7%	10.8%	11.3%	11.7%	9.5%

Figure 6.5: COE estimations for 14 European banks

COE	
ERP	
3%	4.5%
4%	5.6%
5%	6.8%
6%	7.9%
7%	9.1%
8%	10.2%

Figure 6.6: CAPM COE estimations

The Merits and Demerits of Our Proposal

Through a combination of both schemes (market based CoCo bonds and the CEB), the regulator can finally do away with the intrinsic moral hazard of the banking industry as well as dampening the negative effects of the agency costs stemming from the Bail-in. The CEB proposal may seem radical, however as already stated, it mirrors the states' expropriation of failing banks, such as Bankia (2012), SNS (2013) and Banco Espirito Santo (2014). In both the equityholders lose their entire investment on a going-concern basis. The difference is that one is done using public fund, while the other relies on private money. The new equityholders replacing the existing equityholders would hopefully instill the necessary discipline to bolster capital and redirect the bank towards a viable business path. Further, upon breaching its PONV, the existing CoCo bonds would replenish the CT1 while a new CEB would be set up to achieve the minimum T1, conveying comfort to the market to raise new equity and operate as a solid going-concern entity.

Overall we believe the trade-off between risks and rewards are well balanced across the different actors:

- Existing equityholders: This proposal is not ROE dilutive for existing equityholders even if the CEB line is still active as it is kept off-balance sheet. The bank will have to honour the contingent equity line fee as if they were preference shares, however they do not participate in any dividend payout or shareholder repurchase. The equityholders have the incentive to hoard capital and raise equity (through net income or equity contribution) to cancel the CEB line. They lose their entire investment once the PONV is breached, however it would also face full dilution if the bank were to be expropriated.¹⁷ Conversely, the bank will be well capitalized at all times leading to lower cost of equity (via beta) and cost of debt, and overall the WACC, which would help to boost the overall profitability, and hence its ROE, of the bank. The requirement to impose losses on further unsecured debt such as senior debt would also no longer be necessary.
- CEB: The CEB commits capital which is at risk of being converted to equity, and charges a fee for this commitment. Though it will receive the equity for free from the existing equityholders upon a distressed event, there are strings attached to it. The CEB will have to be fully involved in the recapitalization process and perhaps even contribute more money of their own since there could be more potential losses and impairments in the balance sheet after the CoCo triggers, or the bank could struggle to rebuild solvency. By charging an onerous fee equivalent to the COE, the CEB structure will encourage equityholders to strive to replenish capital.
- Bondholders: the harmful Bail-in related agency costs vanish and, despite the DAPR still not fully restored (the equity is not fully consumed before their investment is forced to be written-down), the bondholders face a relatively more benign restructuring.¹⁸ Therefore, they are no longer at the mercy of equityholders that can free-ride

¹⁷It is true that through Bail-in they preserve most of their investment, but it is this benefit of bail-in that gives rise to the agency costs while potentially aggravating the moral hazard problem.

¹⁸They even stand to recoup their losses if, in due course, share price recovers to make up for their initial

on their investment. Furthermore, with our proposal the debt-to-equity exchange takes place at market prices instead of transferring wealth through the NADES of the currently issued CoCo bonds.

- Regulator: it stands to benefit the most, due to the permanent recapitalization of the bank even in a distressed event. Effectively it can delegate bank monitoring to the market and rid itself from its traditional role of rescuer of last resort.

Though the scheme has its merits, the proposal also has its shortcomings. We envisage two main problems with mitigating factors:

- Existing equityholders and equity valuation: will they accept a scheme whereby they can lose their entire investment on a going-concern basis? How will the CEB and the CEB line affect the valuation of the existing shares?
- CEB: Would there be sufficient support and appetite in the market to become contingent equityholders of systematically important banks and to some extent commit resources, especially through the CEB line?

As far as the former is concerned it is obvious that equityholders will not be pleased with the new framework. However, neither Bail-out nor the existing Bail-in frameworks are viable alternatives as they aggravate moral hazard and agency cost problems respectively. The current set-up must change and the equityholders come into terms that once the bank reaches the PONV, the going-concern value of their equity investment is similar to the gone-concern recovery value of zero, in spite of the difficulty of liquidating a bank due to the systemic risks attached to it. Therefore, equityholders should revise their investment stance on a highly levered vehicle like a bank and balance out the risk and rewards of their investment. The CEB line is not ROE dilutive however it is ROE consuming, as the bank has to pay a fee in the same way it serves the fee for its preference shares and subordinate bonds. The bank will then have to decide whether it should raise capital immediately to cancel this contingent equity line on the basis of its burdensome costs (because the bank

debt to equity swap loss, unless they are forced to sell equity as many CoCo bondholders are fixed income investors and cannot hold equity.

believes his COE is lower than the fee), or maintain it because of its belief that it can earn a higher return on capital elsewhere (if the COE is higher than the fee). We proposed above that the CEB line should be priced to the COE, which should encourage the bank to raise equity.

Moreover, we believe the COE should drop via lower beta (lower financial leverage thanks to the permanent capitalization) and higher equity. Higher equity means that the Cost of Debt (COD) should also fall due to less Bail-in-able debt required and lower coupons for the issued CoCo bonds, improving the overall WACC of the bank. However, what seems inevitable is the premium demanded for holding banks' shares by investors, making the ownership of banks' shares a target to sophisticated investors that better understand the risk-reward of the investment. Overall, we believe the new scheme should not meaningfully affect the traditional relation between P/B ¹⁹ and ROE.

As regards the latter, the amount of monetary equity commitment required to set up the CEB line at the moment is not very significant, bearing in mind that banks have come a long way in restoring and boosting capitalization. As we can observe in Fig 6.7, most of the too-big-to-fail (TBTF) banks now boast a fully-loaded CT1 (FLCT1) of above 10%, close to the expected minimum levels of 11 – 11.5%.²⁰ Indeed the average FLCT1 of the 14 banks is 10.3%, with, for example, Intesa Bank at nearly 12.5%. We view, therefore, that the contingent equity required to accomplish this scheme is financially digestible to the market. As of 31 January 2015, the FLCT1 shortfall of the 14 biggest banks in the EU, is estimated to be €62bn assuming a 11.5% minimum level. The shortfalls at each bank is demonstrated in Fig 6.8.

If we exclude the existing non-compliant T1 debt (which we expect to be called or tendered) the fully-loaded T1 (FLT1) shortfall would be close to €110bn. The shortfalls at each bank is demonstrated in Fig 6.9. We believe a combination of equity and CoCo bonds should plug-in this capital shortfall in a reasonable amount of time, especially given the low

¹⁹ P/B would reflect both the lower ROE (due to the CEB fee) and COE (via lower beta). However in the long-run, the bank would be in a better condition to lend and increase assets to enhance its ROE, which would have a positive impact on its equity multiples.

²⁰Recent trends from the UK and Euro zone regulator suggest higher CT1 than previously discussed and hence a 11 – 11.5% minimum CT1 is not far-fetched.

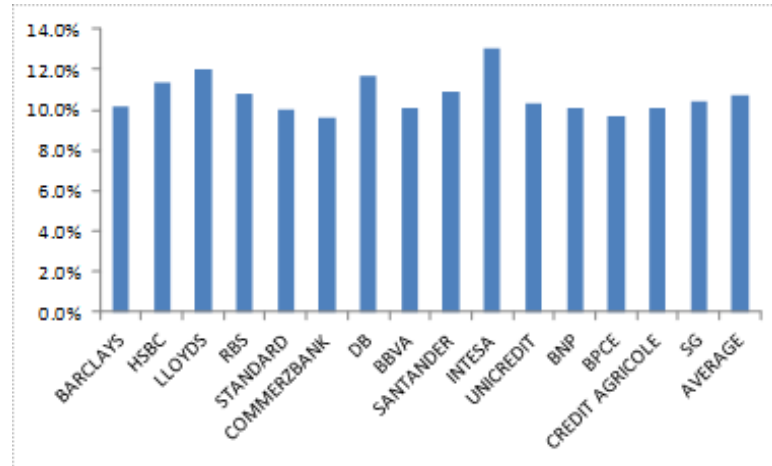


Figure 6.7: FLCT1 at 14 banks. Source: Bloomberg and author. Date: 19th March 2015.

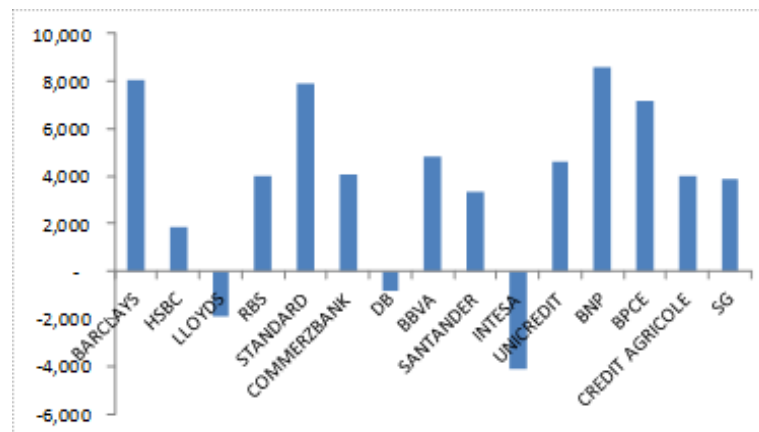


Figure 6.8: FLCT1 shortfall at 14 banks. Source: Bloomberg and author. Date: 19th March 2015.

yielding environment and the improving fundamentals of the banks.

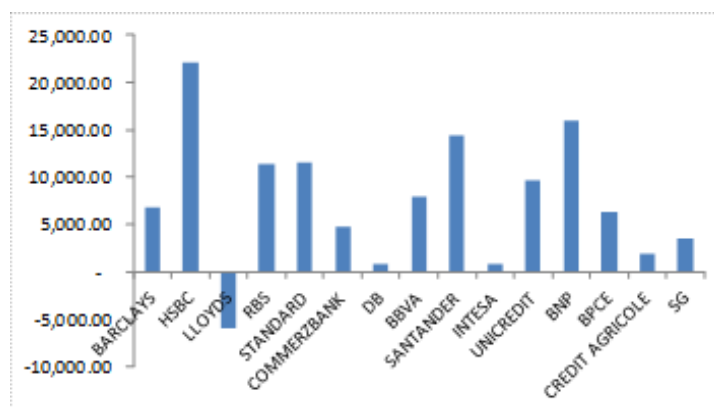


Figure 6.9: FLT1 shortfall at 14 banks. Source: Bloomberg and author. Date: 19th March 2015.

Should a bank fail and a new CEB line is required, we believe this investment will be palatable to investors unless the fallout of this bank triggers a chain of bank failures. However, this possibility should diminish overtime owing to the stringent regulation on cross holding stakes among banks that will force banks out of owning each other shares²¹. For example if Barclays Bank were to fail, the amount of equity and CoCo bonds necessary to boost the capital ratios from CT1 and T1 ratios of 10%²² to 11.5% CT1 and 14% T1 would be €5bn and €10bn, respectively.

In the current low yield climate, earning a COE-equivalent fee to hold contingent equity is fairly attractive deal for investors as banks carry on restoring and bolstering capital. Fig 6.10 is a scatter graph of the banks' ROE vs their P/E ratios. It demonstrates that the banks are trading at the P/B ratio of 0.7 for a 2015 expected ROE of 7%, implying that the banks are barely covering their COE given how depressed banks' ROEs are. Consequently, for CEB investors to earn a 8% fee (assuming a 6% ERP) to become contingent equityholders of a bank looks like an attractive proposition in this low yield environment. In Fig 6.11, we

²¹Financial equities positions are coming now with either 200% or 1,250% RWA factor. Significant exposures are deducted from Core Tier 1.

²²This is the assumed level of CT1 after CoCo bail-in and CEB takeover (see the examples in Appendix 6.6.2). Note if all CoCo bonds are converted into equity then the T1 ratio would equal this CT1 ratio.

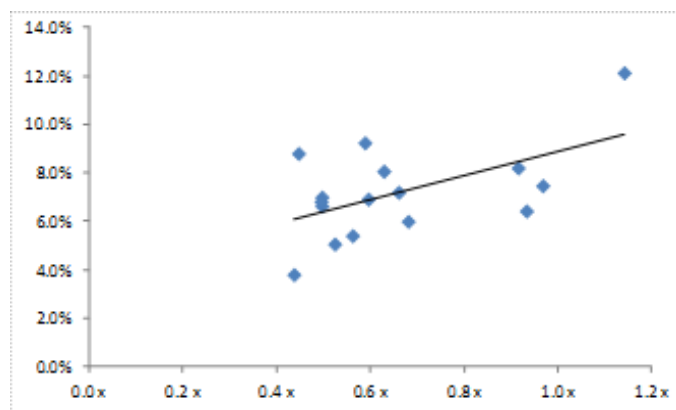


Figure 6.10: ROE vs P/B ratio. Source: Bloomberg and author. Date: 19th March 2015.

can observe that the CAPM COE fee looks compelling relative to other equity (or equity linked) valuation methods such as the dividend yield, and the existing yield on T1 CoCo bonds.

6.3 Concluding Remarks

As has been argued throughout the thesis, we believe Bail-in will prove not to solve the moral hazard problem that is the short-fall of Bail-out schemes. Moreover, it incorporates an additional problem which is the lurking agency costs that lie behind the new relationship between equityholders and bondholders.

We believe that covenants in CoCo bonds proposed in this Chapter are an effective way to curb risk-taking. When solvency is high, contractual covenants will swiftly incorporate the additional risk premium via upward coupon resetting that exerts discipline on banks and dents shareholder returns. The equityholders are not able to trade easily the bank value off against volatility for two reasons: the concave nature of the equityholders' return on equity at each ratchet trigger point, and the higher cost of capital once triggered. As solvency deteriorates towards the CoCo trigger or the PONV these become less effective (as well as the fact that higher coupons erode solvency even more) as the equityholders' incentive to "gamble-for-resurrection" negate the above effects, and at this point, when CoCo

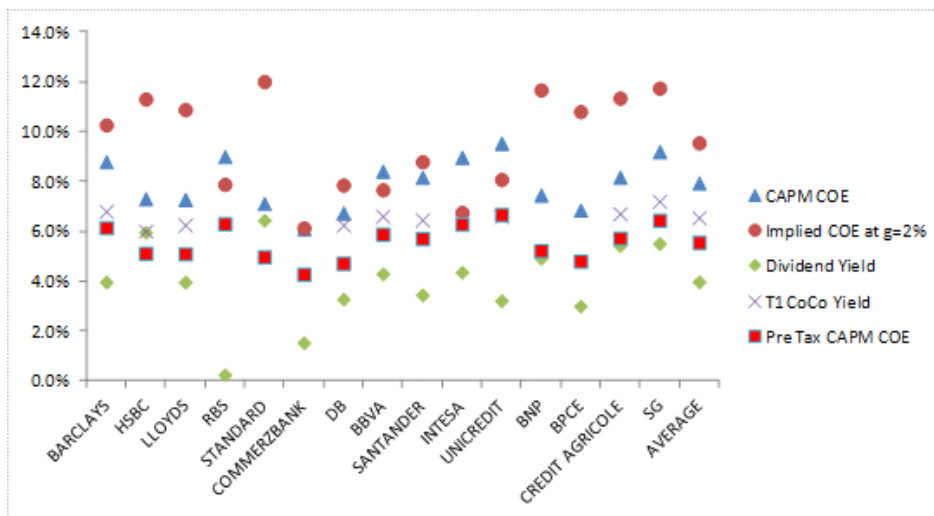


Figure 6.11: COE, Dividend yield and T1 CoCo bond yield at 14 banks. Source: Bloomberg and author

bonds trade at distress, the monitoring effort becomes no longer fruitful. In these cases we propose a different type of covenants, namely asset and debt sweeps.

In this chapter, we also investigate in more detail the currently employed CoCo formats and make alternative suggestions. The writedown CoCo bond creates a huge incentive for “gambling for resurrection” and therefore should be abolished. The equity-conversion CoCo bond is a form of non-admissible debt-to-equity swap (NADES) that presets the conversion price in advance which results in offsetting the dilution effect of Bail-in conversion. Alternatively, we propose a CoCo bond that converts at the prevailing share price with a discount, where the CoCo trigger mirrors the equity raise that would occur at these distressed levels. Consequently, bondholders would be converted at a fair price, diluting the equityholders’ position as would happen in a distressed equity raise. Therefore, the equityholders would have an incentive to curtail risk-taking and raise equity before the “painful” dilution sets in.

Notwithstanding that, the new CoCo bond proposal does not eliminate entirely the agency costs problem. Equityholders could still decline any equity raise and attempt “gamble for resurrection”, as they can rely on the contingent capital provided by CoCo

bondholders to aid them recover some of their capital in the case that their “gamble” does not pay off. We, therefore, suggest a novel approach to permanently extinguish the moral hazard and the Bail-in agency costs by creating a Contingent Equity Base (CEB) contributed by future equityholders. If existing equityholders face full dilution on a going concern basis, as would be the case if full expropriation occurs in a similar fashion to Bankia, SNS or Banco Espirito Santo rescues in 2012-14, equityholders would have a strong incentive to avoid the solvency falling close to the PONV/CoCo trigger. In this environment, where banks are bolstering capital, the necessary equity support for the too-big-to-fail banks would hopefully be economically palatable. Our proposal suggests a generous fee for the CEB using the cost of equity. From the recovery value standpoint, having this equity-line obviously makes existing equityholders worse off compared with the existing structure. However, in the current format Bail-in has inherent risks that are currently not fully considered. We strongly advocate replacing it with a scheme where equityholders can face full expropriation should their financial and business decisions turn out to be incorrect, removing the perverse incentive to misbehave. Our CEB proposal that mimics the full going-concern equityholders expropriation accomplishes this.

6.4 Appendix

6.4.1 Market-price Equity-conversion CoCo Bond

The payoffs and the losses for the equityholders and the bondholders for the market-price equity-conversion CoCo bond described in the text are,

V_t	$0, \frac{F_B}{1-\underline{E}}$	$\left(\frac{F_B}{1-\underline{E}}, \frac{F}{1-\tau}\right)$	$\left(\frac{F}{1-\tau}, V_0\right)$	$[V_0, \infty]$
D_B	$(1-\underline{E})V_t$	F_B	F_B	F_B
D_C	0	$(1-\underline{E})V_T - F_B$	F_C	F_C
E_C	$\frac{(\underline{E}-\tau)}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}\underline{E}V_t$	$\frac{(\underline{E}-\tau)}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}\underline{E}V_T$	0	0
E_E	$\frac{\lambda\tau(1-\delta)}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}\underline{E}V_T$	$\frac{\lambda\tau(1-\delta)}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}\underline{E}V_T$	$V_T - F$	$V_T - F$
L_B	$F_B - (1-\underline{E})V_T$	0	0	0
L_C	$F_C - \frac{(\underline{E}-\tau)\underline{E}}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}V_T$	$F - \frac{(1-\underline{E})\lambda\tau(1-\delta)+(\underline{E}-\tau)}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}V_T$	0	0
L_E	$(V_0 - F) - \frac{\lambda\tau(1-\delta)\underline{E}}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}V_T$	$(V_0 - F) - \frac{\lambda\tau(1-\delta)\underline{E}}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}V_T$	$V_0 - V_T$	$V_0 - V_T$
Notes	All CoCo converted. D_B written down.	τ breached. CoCo partially converted.	τ not breached. E_E written down.	Balance sheet expanding.

These can be expressed as,

$$D_B^{MPCBI} = \min[(1 - \underline{E})V_T, F_B]$$

$$D_C^{MPCBI} = \max[(1 - \underline{E})V_T - F_B, 0] + [F - (1 - \underline{E})V_T]\chi_{V > \frac{F}{1-\tau}}$$

$$E_C^{MPCBI} = \frac{(\underline{E}-\tau)}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}\underline{E}V_T\chi_{V \leq \frac{F}{1-\tau}}$$

$$E_E^{MPCBI} = (V_T - F) + \left[F - \frac{\lambda\tau(1-\delta)(1-\underline{E})+(\underline{E}-\tau)}{\lambda\tau(1-\delta)+(\underline{E}-\tau)}V_T\right]\chi_{V_T \leq \frac{F}{1-\tau}}.$$

6.4.2 Contingent Equity Base

Again let the firm's initial asset value be V_0 , with the face values of vanilla bonds and the equity-conversion CoCo bond given by F_B and F_C , respectively, such that $F = F_B + F_C$. Assume that initially the CT1 and T1 ratios, \underline{E} and T , are fulfilled, i.e. $\frac{V_0 - F}{V_0} \geq \underline{E}$ and $\frac{V_0 - F_B}{V_0} \geq T$. In the case that the bank fails to maintain its required T1 ratio, then a contingent line of E_{T_1} is kept off-balance sheet by the CEB providers. The CoCo trigger level is τ . Upon trigger, E_{CEB} denotes the capital expropriated by the CEB investors from the original equityholders. Then,

- For $V_T > \frac{F}{1-\tau}$, the CT1 capital ratio is above τ . therefore as in the ordinary equity-conversion case, $D_B = F_B$, $D_C = F_C$ and $E_E = V_T - F$, with the equityholders bearing all of the loss, $L_E = V_0 - V_T$.
- For $V_T \leq \frac{F}{1-\tau}$, the CoCo conversion is triggered. Here the equityholders' position is then wholly expropriated by the CEB investors. Therefore $E_E = 0$, $L_E = V_0 - F$ and $E_{CEB} = \tau V$. V_T s with the ordinary equity-conversion the CoCo bond is partially converted to equity such that $D_C = (1 - \underline{E}) V_T - F_B$, $E_C = (\underline{E} - \tau) V_T$ and $L_C = F - (1 - \tau) V_T$. The vanilla bondholders are unaffected and so $D_B = F_B$ and $E_B = L_B = 0$. Furthermore, $E_{T_1} = 0$ as long as $\frac{D_C + E_C + E_{CEB}}{V_T} = \frac{V - F_B}{V_T} > T \Leftrightarrow V_T > \frac{F_B}{1-T}$.
- For $V_T \leq \frac{F_B}{1-T}$, the T1 capital ratio breaches the minimum required ratio T . Then the CEB investors provide $E_{T_1} = F_B - (1 - T) V_T$ of contingent line. In the long-run the bank will be required to replace this amount of vanilla bond with T1 securities (equity or CoCo bond) to bring the T1 ratio up to T . As they do so this contingent line will be drawn down. As this contingent line is kept off-balance sheet the total balance sheet remains at V_T and the positions and losses of all stakeholders remain the same as in the $\frac{F_B}{1-T} < V_T \leq \frac{F}{1-\tau}$ case above.
- For $V_T \leq \frac{F_B}{1-\underline{E}}$, the whole of CoCo bond is converted, i.e. $D_C = 0$, $E_C = (\underline{E} - \tau) V$ and $L_C = F - (\underline{E} - \tau) V$. As above the CEB investors take over the original equityholders' position, and therefore $E_E = 0$, $L_E = V_0 - F$ and $E_{CEB} = \tau V_T$. To cover the remaining loss, the vanilla bonds are forced to be written down, with $D_B = (1 - \underline{E}) V_T$ and $L_B = F_B - (1 - \underline{E}) V_T$. Furthermore, the CEB investors provide the contingent line of $E_{T_1} = (T - \underline{E}) V_T$ off-balance sheet.

Therefore,

V	$0, \frac{F_B}{1-\underline{E}}$	$\left(\frac{F_B}{1-\underline{E}}, \frac{F_B}{1-T}\right)$	$\left(\frac{F_B}{1-T}, \frac{F}{1-\tau}\right)$	$\left(\frac{F}{1-\tau}, V_0\right)$	$[V_0, \infty]$
D_B	$(1-\underline{E})V_T$	F_B	F_B	F_B	F_B
D_C	0	$(1-\underline{E})V - F_B$	$(1-\underline{E})V_T - F_B$	F_C	F_C
E_C	$(\underline{E}-\tau)V_T$	$(\underline{E}-\tau)V_T$	$(\underline{E}-\tau)V_T$	0	0
E_E	0	0	0	$V_T - F$	$V_T - F$
E_{CEB}	τV_T	τV_T	τV_T	0	0
E_{T_1}	$(T-\underline{E})V_T$	$F_B - (1-T)V$	0	0	0
L_B	$F_B - (1-\underline{E})V_T$	0	0	0	0
L_C	$F_C - (\underline{E}-\tau)V_T$	$F - (1-\tau)V_T$	$F - (1-\tau)V_T$	0	0
L_E	$V_0 - F$	$V_0 - F$	$V_0 - F$	$V_0 - V_T$	$V_0 - V_T$
Notes	All CoCo converted. D_B written down.	T breached. CoCo partially converted. Contingent line provided off-balance sheet.	τ breached. CoCo partially converted.	τ not breached. E_E written down.	Balance sheet expanding.

The summarized payoffs are,

$$\begin{aligned}
D_B^{CEB} &= \min[(1-\underline{E})V_T, F_B] \\
D_C^{CEB} &= \max[(1-\underline{E})V_T - F_B, 0] + [F - (1-\underline{E})V] \chi_{V > \frac{F}{1-\tau}} \\
E_C^{CEB} &= (\underline{E}-\tau)V \chi_{V_T \leq \frac{F}{1-\tau}} \\
E_E^{CEB} &= (V-F) \chi_{V_T > \frac{F}{1-\tau}} \\
E_{CEB}^{CEB} &= \tau V \chi_{V_T \leq \frac{F}{1-\tau}} \\
D_{T_1}^{CEB} &= (1-T) \max\left[\frac{F_B}{1-T} - V_T, 0\right] - (1-\underline{E}) \max\left[\frac{F_B}{1-\underline{E}} - V_T, 0\right].
\end{aligned}$$

By letting $V_0 = 110$, $F_B = 80$, $F_C = 10$, $\tau = 7\%$, $\underline{E} = 10\%$ and $T = 14\%$,

$\frac{F}{1-\tau} = 96.77$, $\frac{F_B}{1-T} = 93.02$ and $\frac{F_B}{1-\underline{E}} = 88.89$. Then,

V	80.0	85.0	88.89	90.0	93.2	95.0	96.77	100.0	105.0	110.0
D_B	72.00	76.50	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
D_C	0	0	0	1.00	3.72	5.50	7.09	10.00	10.00	10.00
E_C	2.40	2.55	2.67	2.70	2.79	2.85	2.90	0	0	0
E_E	0	0	0	0	0	0	0	10.00	15.00	20.00
E_{CEB}	5.60	5.95	6.22	6.30	6.51	6.65	6.77	0	0	0
E_{T_1}	3.20	3.40	3.55	2.60	0	0	0	0	0	0
L_B	8.00	3.50	0	0	0	0	0	0	0	0
L_C	7.60	7.45	7.33	6.30	3.49	1.65	0	0	0	0
L_E	20.00	20.00	20.00	20.00	20.00	20.00	20.00	10.00	5.00	0
CT1 ratio	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	14.3%	18.2%
T1 ratio	10.0%	10.0%	10.0%	11.1%	14.0%	15.8%	17.3%	20.0%	23.8%	27.3%

6.4.3 P/B Ratio

Let the bank's return-on-equity (ROE) be R , and its net income and book value at time t be NI_t and BV_t , respectively. Assume that R is constant over time. Then,

$$R = \frac{NI_t}{BV_t} = \frac{NI_{t+1}}{BV_{t+1}}. \quad (6.28)$$

Now at t , NI_t is split into dividend d_t and retained earnings RE_t . Then $BV_{t+1} = BV_t + RE_t$. The growth rate g is that of the net income, i.e.

$$g = \frac{NI_{t+1}}{NI_t} - 1 = \frac{BV_{t+1}}{BV_t} - 1 = \frac{RE_t}{BV_t}. \quad (6.29)$$

The second equality uses (6.28), while the third equality results from substituting for BV_{t+1} . Therefore $RE_t = g \cdot BV_t$ and similarly $RE_{t+1} = g \cdot BV_{t+1}$. Now from Gordon Growth Model the market value at t is,

$$MV_t = \frac{d_{t+1}}{k - g}, \quad (6.30)$$

where k is the bank's COE. Then,

$$MV_t = \frac{NI_{t+1} - RE_{t+1}}{k - g} = \frac{NI_{t+1} - g \cdot BV_{t+1}}{k - g} = \left(\frac{R - g}{k - g} \right) BV_{t+1} = \left(\frac{R - g}{k - g} \right) (1 + g) BV_t. \quad (6.31)$$

Hence,

$$\frac{MV_t}{BV_t} = \left(\frac{R - g}{k - g} \right) (1 + g).$$

6.4.4 Equity Risk Premium

Fig 6.12 is an example of the estimated UK ERP for the market according to the UK utility regulator Ofcom, while Fig 6.13 demonstrates the difference between the historical ERP between UK and the World.

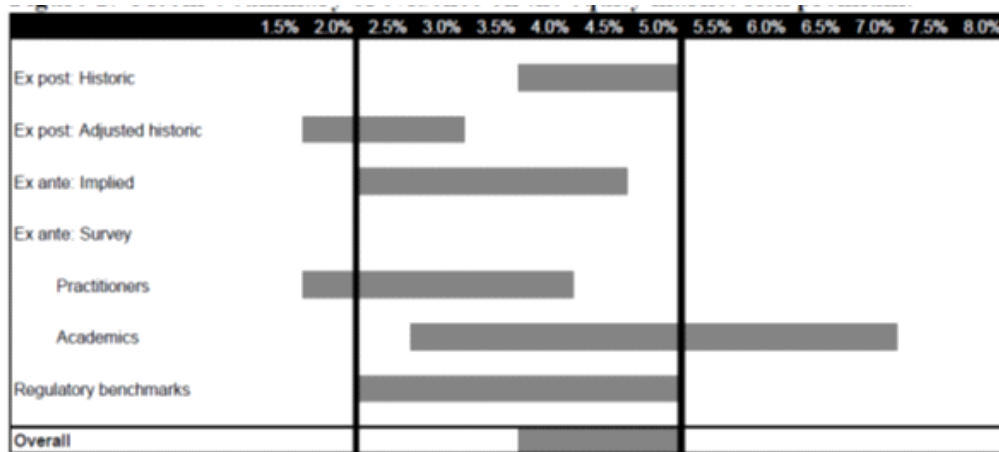


Figure 6.12: UK ERP; Source: Evidence on the equity market risk premium, Cooper (2005)

	UK	World
Method A:		
Historical geometric mean premium vs bills ¹	4.3	4.6
Adjustment (market re-rating) ²	0.3	0.8
Adjusted geometric mean premium vs bills	4.0	3.8
Adjustment (geometric to arithmetic) ²	2.0	1.3
Forecast relative to bills	6.0	5.1
Bond minus bill premium ¹	0.7	0.9
Forecast relative to bonds (A)	5.3	4.2
Method B:		
Arithmetic premium relative to bonds ¹	5.3	5.1
Adjustment (market re-rating) ²	0.3	0.8
Forecast relative to bonds (B)	5.0	4.3

Figure 6.13: Historical ERP Between UK and the World; Source: Dimson (2004)

Chapter 7

Cost of Capital Under Basel III Bail-in

Admati, DeMarzo, Hellwig and Pfleiderer (2011) argue that higher equity requirements under the new regulation would lower both the cost of equity and the cost of debt, and therefore despite the change in the funding mix (more equity which has the higher cost), the weighted-average cost of capital (WACC) should remain unchanged. In contrast, we believe that the WACC increase meaningfully on the back of Bail-in (especially at the senior debt level) and the monitoring costs (throughout the entire unsecured debt). To demonstrate this, in this chapter we estimate the pre- and post-Basel III WACC for the 16 largest European banks using the September 2014 quarterly reports and the market data as of beginning of October 2014, under sensible assumptions. A sensitivity analysis is then undertaken to test the robustness of the results on our assumptions. This yields a range of possible WACC estimates which are 75% to 110% higher than the current WACC level.¹ This will have effects on the behaviours of the bank, some of which are discussed in the concluding remarks.

In this section we investigate the impact of the new regulatory capital measures,

¹The argument goes as follows. Despite banks having the incentive to issue secured debt (out of the scope of Bail I), they still have to issue unsecured debt which falls within the Total Loss Absorbing Capacity (TLAC) and MREL (Minimum Regulatory Eligible Liabilities) ratios and issue long term debt to meet the Net Stable Funding Ratio (NSFR). This comes at a cost that filters through to the overall cost of debt, which we believe will outweigh the supposedly lower cost of equity.

namely Bail-in and CoCo bonds, on the cost of capital (WACC) of the banks. So far, we have argued that to counter the agency costs of wealth transfer and value destruction, bondholders, facing going concern losses, requires to continuously monitor the risk appetite of the bank. This is not free. For instance a traditional passive fund will now have to hire a team of analysts to monitor their financial bonds. Similarly, the use of covenants we advocated in Chapter 6 comes with a cost, as bondholders are now required to monitor the status of the covenants and the banks' fundamentals (as is typical of the high yield corporate bond market). These additional costs borne by the bondholders are passed on to the equityholders via higher cost of debt. For the current market, we believe that the prices of the existing CoCo and Senior bonds do not reflect this monitoring cost, especially for banks where senior bonds qualify for the total loss-absorbing capacity (TLAC) of the banks. The low yielding environment and the financial repression has allowed banks to place these bonds at very low rate levels which moreover do not incorporate the increasing agency costs of Bail-in. This will change over time as yields rise and bondholders come to grips with the reality of Bail-in and the DAPR.

Banks' WACC are affected by the new regulatory framework that requires higher equity and loss-absorbing debt. Admati, DeMarzo, Hellwig and Pfleiderer (2011) argue that higher equity requirements would lower both the cost of equity and the cost of debt, and therefore despite the change in the funding mix (more equity which has the higher cost), the WACC should remain unchanged. In contrast we believe that the WACC would meaningfully rise. To demonstrate this, we now estimate the pre- and post-Basel III WACC for the 16 largest European banks using the September 2014 quarterly reports and the market data as of beginning of October 2014. Later, a sensitivity analysis is then undertaken to test the impact that our assumptions on the main variables have on the WACC to derive a range of possible WACC estimates.

7.1 WACC Analysis

7.1.1 Pre-Basel III WACC

We estimate the pre-Basel III WACC by estimating its components, the COE and the COD. The COE is estimated by the CAPM using,²

- Risk free rate - 10 year sovereign bond yield of the country where the bank has its main operations;³
- β - 2 year adjusted β for each bank; and
- Equity risk premium - the embedded ERP in the equity market of the bank where it has its main operations.⁴

The most critical factor here is the β . The β of a bank is driven by three factors: operating leverage ($= \frac{\text{fixed costs}}{\text{total costs}}$), financial leverage ($= \frac{\text{debt}}{\text{equity}}$) and earnings volatility ($=$ volatility of ROE), with the financial leverage being the most relevant. The table in figure 7.1 demonstrates these main drivers for different banks.⁵

All three factors are revealed to be high at this point, especially the operating and financial leverages. The operating leverage should drop in the volatile investment banking business of banks due to the onerous capital charges stemming from Basel III (indeed many banks are scaling down or even dismantling their investment banking operations⁶). On the other hand, it should not meaningfully fall in the retail banking business which is characterized by a high fixed cost base (offices, NPL related provisions, etc.). Therefore we

²As our sample of banks comprises big banks, we exclude any risk premium for small size or idiosyncratic risk for the bank. Despite the main limitations of CAPM, including homogeneous expectations and no transaction costs, we still believe that the model is useful for a good “proxy” of the cost of capital of banks.

³The correlation between sovereign and financial bond yields are still very high, and thus financial bond spreads still incorporate the sovereign bond premium.

⁴There are many approaches to calculate ERP (e.g. Damodaran (2013), Graham and Dodd (2011)). We follow a Gordon discount dividend model (DDM), accounting for share repurchases, using Bloomberg market consensus expected dividends payouts for the stock exchange of the bank. DDM models perform better in predicting future equity returns than Residual Income Models. It is also forward-looking rather than based on historical data.

⁵The last column “Type of Business” is the proportion of retail business within the banks’ global earnings and represents the earnings volatility - the higher the retail business (as opposed to wholesale or investment banking), the lower the earnings volatility.

⁶RBS, Barclays, etc.

Beta Analysis	Beta Determinants		
	Operating leverage	Financial leverage	Type of business
BARCLAYS	71%	22.8x	42%
HSBC	60%	16.1x	55%
LLOYDS	51%	20.0x	40%
RBS	94%	20.4x	57%
STANDARD	54%	16.1x	60%
COMMERZBANK	73%	26.9x	66%
DB	88%	30.3x	48%
CS	80%	26.0x	22%
UBS	88%	21.4x	21%
SANTANDER	53%	19.7x	65%
BBVA	59%	15.8x	61%
UNICREDIT	72%	17.8x	50%
ISPM	70%	16.6x	64%
BNP	67%	24.9x	53%
CASA	70%	30.0x	87%
SG	72%	25.1x	46%

Figure 7.1: Pre Basel III β Determinants; Source: Bloomberg and author. Date: 19th March 2015.

will observe later that even if the financial leverage decreases post-new financial regulation, there are some intrinsic features of the banking industry that makes the β of the banks higher than the market average of one. Applying these to the CAPM we derive the current estimates of COE in Figure 7.2. The average is revealed as 13%. The pre-Basel III COD is estimated using the average interest spread of the banks' liabilities (such as deposits, covered, senior, subordinate bonds, etc.), demonstrated in Figure 7.3. The average pre-tax COD is computed to be 2.1%. Finally the pre-tax WACC is estimated in Figure 7.4, which demonstrates the current average of 2.7% for the 16 European banks.

Note that the COE can also be derived as the market implied COE from the current share price, using the market consensus 2016 ROE (taken from Bloomberg) and a terminal growth rate of 1.5%. The table in Figure 7.5 demonstrates both the CAPM COE derived above and the market implied COE. The latter is lower than the former due to technical reasons (abundant liquidity, central bank interventions, Quantitative Easing, etc.) The table demonstrates that the banks' ROE will struggle to cover their COE in the

COE	RFA	Beta	ERP	COE	Equity	Equity Weighting
BARCLAYS	2.51%	1.28	9.03%	14.1%	65,025	4.9%
HSBC	2.51%	1.07	9.03%	12.2%	198,722	7.2%
LLOYDS	2.51%	0.99	9.03%	11.5%	45,878	5.4%
RBS	2.51%	1.29	9.03%	14.1%	60,963	6.0%
STANDARD	2.51%	1.02	9.03%	11.8%	48,562	7.0%
COMMERZBANK	1.06%	1.07	8.94%	10.6%	24,629	4.2%
DB	1.06%	1.09	8.94%	10.8%	68,401	4.1%
CS	0.52%	1.27	8.31%	11.1%	42,027	4.7%
UBS	0.52%	1.25	8.31%	11.0%	51,449	5.2%
SANTANDER	2.33%	1.09	10.26%	13.5%	85,716	7.2%
BBVA	2.33%	1.19	10.26%	14.6%	46,867	7.6%
UNICREDIT	2.45%	1.34	10.61%	16.7%	52,172	6.2%
ISPM	2.45%	1.29	10.61%	16.1%	44,773	7.1%
BNP	1.44%	1.21	9.23%	12.6%	88,270	4.6%
CASA	1.44%	1.30	9.23%	13.5%	51,946	3.4%
SG	1.44%	1.53	9.23%	15.5%	56,860	4.3%
Average				13.1%		

Figure 7.2: Pre Basel III COE; Source: Bloomberg and author. Date: 19th March 2015.

COD	Current RFA	Spread	After tax COD	Debt Weighting
BARCLAYS	2.51%	0.5%	2.1%	95.1%
HSBC	2.51%	0.6%	2.2%	92.8%
LLOYDS	2.51%	1.7%	3.0%	94.6%
RBS	2.51%	0.6%	2.2%	94.0%
STANDARD	2.51%	1.0%	2.5%	93.0%
COMMERZBANK	1.06%	1.4%	1.7%	95.8%
DB	1.06%	0.7%	1.2%	95.9%
CS	0.52%	1.3%	1.3%	95.3%
UBS	0.52%	0.8%	0.9%	94.8%
SANTANDER	2.33%	2.3%	3.2%	92.8%
BBVA	2.33%	1.7%	2.8%	92.4%
UNICREDIT	2.45%	1.5%	2.7%	93.8%
ISPM	2.45%	1.3%	2.6%	92.9%
BNP	1.44%	1.0%	1.7%	95.4%
CASA	1.44%	1.1%	1.8%	96.6%
SG	1.44%	1.4%	2.0%	95.7%
Average			2.1%	

Figure 7.3: Pre Basel III Pre Tax COD; Source: Banks' quarterly reports and author. Date: 19th March 2015.

WACC	
BARCLAYS	2.7%
HSBC	2.9%
LLOYDS	3.4%
RBS	2.9%
STANDARD	3.1%
COMMERZBANK	2.1%
DB	1.6%
CS	1.8%
UBS	1.4%
SANTANDER	4.0%
BBVA	3.7%
UNICREDIT	3.6%
ISPM	3.6%
BNP	2.2%
CASA	2.2%
SG	2.5%
Average	2.7%

Figure 7.4: Pre Basel III Estimated Pre tax WACC; Source: author. Date: 19th March 2015.

current environment.⁷

7.1.2 Post-Basel III WACC Estimation

We now compute the post-Basel III estimates of the cost of debt using Basel III and Bail-in guidelines. The analysis is based on some assumptions regarding the future solvency rules for banks. At the end of this section we run some sensitivity test on the main assumptions to determine a potential WACC range for our sample of banks.

We start with the estimated Basel III RWA for the banks based on their last quarterly update. There is only a 7% increase versus the phase-in Basel III RWA,⁸ highlighting the banks' potential leeway to continue their deleveraging strategy to boost solvency ratios.

⁷The ROE should remain subdued due to reasons such as capital bolstering (deleveraging), onerous capital charges on traditional high ROE businesses (derivatives, off balance sheet businesses), low interest rates and operating leverage (income is decreasing whereas fixed costs remain stubbornly stable).

⁸The phase-in Basel III is the current Basel III RWA or CT1 without making all the adjustments of the fully-loaded Basel III figure. Banks are currently reporting this number to show investors how they are building their solvency towards achieving the fully-loaded Basel III CT1.

Excess Returns	2016 ROE	CAPM COE	Implied COE	CAPM/COE	
				CAPM ROE- COE	/Implied COE
BARCLAYS	8.2%	14.1%	11.1%	-5.87%	1.3x
HSBC	10.0%	12.2%	14.2%	-2.18%	0.9x
LLOYDS	13.2%	11.5%	11.6%	1.66%	1.0x
RBS	6.0%	14.1%	8.1%	-8.11%	1.8x
STANDARD	10.5%	11.8%	15.2%	-1.28%	0.8x
COMMERZBANK	4.8%	10.6%	5.7%	-5.75%	1.8x
DB	7.8%	10.8%	9.5%	-2.97%	1.1x
CS	12.6%	11.1%	10.5%	1.45%	1.1x
UBS	10.0%	11.0%	8.8%	-0.96%	1.2x
SANTANDER	11.9%	13.5%	8.2%	-1.60%	1.7x
BBVA	10.6%	14.6%	7.9%	-3.98%	1.8x
UNICREDIT	6.9%	16.7%	7.6%	-9.82%	2.2x
ISPM	7.8%	16.1%	7.1%	-8.29%	2.3x
BNP	9.2%	12.6%	10.4%	-3.35%	1.2x
CASA	7.6%	13.5%	10.5%	-5.87%	1.3x
SG	8.6%	15.5%	12.2%	-6.91%	1.3x
Average	8.8%	12.4%		-3.6%	

Figure 7.5: Pre Basel III ROE vs COE; Source: author. Date: 19th March 2015.

First we estimate the existing amount of AT1 (Tier 1 CoCo) and T2 (Tier 2) CoCo bonds, as well the average T1 (Tier 1) and T2 coupon, and we convert them to the base currency of the bank. We note that while some banks have not yet issued CoCo bonds, they can still issue up to 1.5% RWA of T1s and 2% RWA of T2s that will count towards the total capital ratio.⁹ The total regulatory capital available for loss absorption is then derived by aggregating the amount of equity, T1 CoCo bonds and T2 CoCo bonds. To simplify the analysis, we assume that all current plain vanilla T1 and T2 bonds will be called or replaced by CoCo bonds over time.¹⁰ Then on the assumption that the banks have to achieve a TLAC of 23% – 25% RWA (or 10% liabilities), we compute the current capital deficit. The banks have four options to plug the deficits, incurring a cost funding premium:

⁹We estimate the total capital ratio for systemic banks at 16% – 18% RWA versus a TLAC close to 23% – 25% RWA (or 10% liabilities).

¹⁰Many of these bonds are either non-Basel III compliant (they have a step-up after the call or incentives to redeem) or they will be amortised through the next ten years and thus they will lose regulatory capital eligibility over time. They still count as regulatory capital, but we believe that those eligible for amortisation will be gradually replaced or called as they become obsolete and illiquid (already the bid-ask spreads of these bonds are in excess of three to four points). This move will be further fuelled by the fact that owning CoCo bonds rather than traditional T1 bonds will become a sign of franchise strength and sophistication as the CoCo bond sector thrives.

- Equity: this will be the most expensive funding source given the high COE in a falling ROE environment.
- CoCo bonds: it will be an expensive source as these bonds come with high triggers and contractual loss-absorbing capacity and hence higher coupons.
- Plain vanilla T2 bonds: a cheaper option at the moment, however we believe that the funding cost of these instruments will rise from the current levels, especially if used as Bail-in-able debt to comply with the TLAC¹¹.
- Senior bonds: this will be the cheapest option, however the cost of funding will obviously increase significantly as it potentially undermines the status of the senior bond market as a funding market (becoming a regulatory capital market)¹².

For the sake of our analysis, we here assume that our sample banks choose the senior bonds, due to the ongoing issuance of CoCo bonds, equities or the likes becoming financially non-viable. With the senior bonds becoming Bail-in-able from 2016, we use a standard *25bp* premium (equivalent to a reasonable monitoring cost) above the existing five year senior CDS for the banks.¹³ We use then an additional premium in excess of this *25bp* that ranges between *10bp*–*50bp* according to the magnitude of the capital deficit, reflecting the fact that banks with a bigger capital deficit will be required to pay higher yield to issue senior debt to comply with the TLAC. To estimate the future cost of the CoCo bonds to achieve the 1.5% RWA and 2% RWA for T1 and T2 CoCo bonds respectively, we use the current average coupons to estimate the reasonable premium to capture the agency cost of Bail-in for CoCo bonds.¹⁴ Using *200bp* for T1, subtracting *150bp* (the current average spread difference between T1 and T2 CoCo bonds) from this yields the T2 CoCo bond coupon.

¹¹French banks are now issuing plain vanilla T2 to boost the loss absorbing capacity of the bank.

¹²Note a senior bondholder is effectively holding a CoCo bond going forward (any unsecured bond is now a loss-absorbing going concern liability). In any case senior bonds will become bail-in-able from 2016. This market would most likely develop into one where issuers differentiate between TLAC senior bonds and non-TLAC senior bonds.

¹³JP Morgan in their last investor survey (2013) on senior bail-in shows that investors expect between *75bp* – *100bp* additional compensation for holding a bail-in-able senior bond.

¹⁴Our estimated T1 CoCo bond coupon is close to our estimated future pre-tax COE, which in our view is where T1 CoCo bonds yield should trade at. There is actually a 60% correlation between the volatility of the equity and the CoCo of a bank.

For those banks which have not issued CoCo bonds so far, we extrapolate the future CoCo bond coupon using a fundamental-bottom up approach.¹⁵ The total Bail-in-able funding cost is then computed using the future cost for the CoCo bonds and the regulatory senior debt. This is demonstrated in Fig 7.6.

To calculate the post-Basel III estimates of COD we use the five year normalised risk-free asset yield which is derived from the ten year normalised risk-free asset yield based on the futures options market, taken from Bloomberg (Figure 7.7). The computed post-Basel III pre-tax COD is demonstrated in Figure 7.8 as to have more than doubled to 4.4% on the back of the new Bail-in rules. To estimate the post-Basel III COE, we use again the CAPM. First, the banks' β are estimated from the adjusted two year Bloomberg β and conducting an unlevering / relevering exercise.¹⁶ TA/TE in Figure 7.9 stands for the ratio of tangible assets to tangible equity and it is the measure of the banks' financial leverage. As demonstrated, on average the sample is levered by 22 times with the average β of 1.21. We unlever this β and relever it using a 12 times TA/TE. This bodes well with a 7 times Basel III leverage ratio¹⁷ which is the regulator's guidance for Systematically Important Banks. This yields a β of 0.88, below the market β of one.¹⁸ Using the normalised ten year risk-free asset and the same ERP as previously, we derive the average post-Basel III COE to be 10.6% (Figure 7.10). Note that given the 2016 ROE Bloomberg consensus, this implies that banks are still unable to cover their COE for the foreseeable future (Figure 7.11). Finally to estimate the post-Basel III WACC, we require the estimates for the future funding mix weighting between equity and debt. For this we assume that the minimum Basel III leverage ratio¹⁹ will be set at 7%, so in taking the current leverage ratio for each bank and stripping out the T1 CoCo bonds, we can compute the necessary equity levels to fulfil this leverage ratio (Figure 7.12). With the estimated COE, COD and the equity

¹⁵For example, HSBC and Standard should have similar CoCo bond coupons given their similar fundamentals. Similarly for BNP and UBS.

¹⁶Here Harris-Pringle formula is used.

¹⁷ $\frac{Equity + AT1\ CoCos}{Assets}$.

¹⁸It is conservative to assume the banks' β of below one. The financial industry, due to its lending and maturity transformation role in the real economy, are characterised by higher leverage and lower equity than the corporate industry. Though Basel III aims to reduce the amount of leverage and increase equity, banks would always run a higher degree of leverage than corporates.

¹⁹ $\frac{Equity + T1\ CoCos}{RWA}$

COD Analysis	Liabilities	RWA	Estimated BORWA	T1 CoCos	T2 CoCos	%T1 CoCos	%T2 CoCos	Average T1 Coupon	Average T2 Coupon	AT1 top up to 1.5%	T2 top up to 2%	Regulatory Capital	Estimate of Basel 3 Bail in Requirement at 10%	B3 8% Requirement Deficit	Senior 5 yr Senior Bonds	CDs	Senior Premium	Normalised 5yr Funding	Bail in able	Future T1 Coupon	Future T2 Coupon	Total Bail in able Funding	Total non Bail in able Funding	Total COD
BARCLAYS	1,249,874	354,809	442,471	4,744	2,424	1.2%	2.4%	5.5%	4.7%	2,383	6,425	80,311	131,490	50,978	49,721	84	50 bps	1.3%	2.8%	7.5%	6.0%	2,079	61,511	63,990
HSBC	2,354,871	1,092,653	1,100,000	2,500	-	0.2%	-	4.5%	3.5%	14,000	22,000	237,222	275,359	38,137	68,767	69	50 bps	1.3%	2.7%	6.5%	5.0%	3,187	105,373	128,570
LLOYDS	798,062	263,850	271,100	5,340	13,978	2.0%	13.9%	6.4%	10%	(1,274)	(8,556)	55,367	84,394	29,028	28,425	94	50 bps	1.3%	2.9%	8.4%	6.9%	1,573	39,252	40,825
RES	950,465	385,300	428,000	-	-	0.0%	-	8.5%	6.5%	6,485	8,580	75,278	101,111	25,133	48,855	116	50 bps	1.3%	3.2%	10.5%	9.0%	2,242	46,697	48,939
STANDARD	641,576	312,251	315,196	-	-	0.0%	-	5.0%	4.0%	4,878	6,504	59,944	68,014	9,070	23,909	99	10 bps	1.3%	2.6%	7.0%	5.5%	984	31,491	32,425
COMMERZBANK	555,074	190,388	250,000	-	-	0.0%	-	8.5%	6.5%	3,750	5,000	33,379	57,990	24,611	19,976	85	50 bps	0.5%	2.3%	10.5%	9.0%	1,422	22,378	23,799
DB	1,597,009	350,143	400,000	3,524	-	1.0%	-	6.6%	5.0%	2,476	8,000	82,401	166,541	84,140	93,208	85	50 bps	0.5%	2.3%	8.6%	7.1%	3,066	64,371	67,427
CS	849,353	273,846	266,000	4,750	5,540	1.7%	5.5%	6.9%	6.4%	(780)	(222)	51,337	89,158	37,821	67,988	70	50 bps	0.3%	2.2%	8.9%	7.4%	1,579	34,218	35,796
BS	931,155	218,557	255,000	-	9,667	0.0%	9.6%	6.0%	5.7%	3,375	(5,167)	59,324	98,260	38,936	39,601	57	50 bps	0.3%	2.1%	8.0%	6.5%	1,368	37,480	38,848
SANTANDER	1,102,327	489,796	450,000	4,154	-	0.8%	-	5.6%	5.0%	2,596	9,000	101,466	118,804	17,338	58,681	85	50 bps	1.2%	2.3%	7.6%	6.1%	1,466	44,259	45,724
BBVA	570,264	313,605	355,996	2,654	-	0.8%	-	7.0%	5.0%	2,886	7,119	59,326	61,713	2,387	22,448	88	10 bps	1.2%	2.0%	9.0%	7.5%	1,057	22,885	23,942
JP MORGAN	786,518	423,799	450,000	1,962	-	0.5%	-	6.5%	5.0%	4,788	9,000	67,522	83,869	15,947	132,078	122	50 bps	1.2%	2.7%	8.5%	7.0%	1,600	31,619	33,248
BNP	583,382	276,291	303,920	-	-	0.0%	-	7.0%	5.0%	4,559	6,078	55,420	63,831	7,420	117,341	91	10 bps	1.2%	2.0%	9.0%	7.5%	1,015	23,432	24,447
BPI	1,818,355	559,632	600,000	-	-	0.0%	-	6.0%	5.0%	9,000	12,000	109,270	190,663	81,393	85,654	78	50 bps	0.7%	2.3%	8.0%	6.5%	3,353	73,246	76,599
CASA	1,466,180	299,600	329,590	2,649	769	0.9%	7.6%	6.2%	6.3%	2,294	5,822	63,481	151,813	88,332	93,578	81	50 bps	0.7%	2.3%	8.2%	6.7%	2,883	59,147	62,040
SS	1,265,757	315,300	342,600	4,462	-	1.4%	-	5.9%	5.0%	677	6,852	68,651	132,262	63,411	59,292	87	50 bps	0.7%	2.4%	7.9%	6.4%	2,353	51,007	53,360

Figure 7.6: Post-Basel III COD. Source: author

RFA	Normaliz ed 5yr RFA	Normaliz ed 5yr RFA
BARCLAYS	1.5%	3.0%
HSBC	1.5%	3.0%
LLOYDS	1.5%	3.0%
RBS	1.5%	3.0%
STANDARD	1.5%	3.0%
COMMERZBANK	1.0%	2.0%
DB	1.0%	2.0%
CS	1.0%	2.0%
UBS	1.0%	2.0%
SANTANDER	1.0%	2.0%
BBVA	1.0%	2.0%
UNICREDIT	1.0%	2.0%
ISPM	1.0%	2.0%
BNP	1.0%	2.0%
CASA	1.0%	2.0%
SG	1.0%	2.0%

Figure 7.7: Normalized 5yr RFA; Source: Author. Date: 19th March 2015.

COD Analysis	Total COD	After tax COD	% Change
BARCLAYS	5.1%	5.3%	150%
HSBC	5.0%	5.3%	141%
LLOYDS	5.1%	5.3%	80%
RBS	5.2%	5.4%	146%
STANDARD	5.1%	5.3%	115%
COMMERZBANK	4.3%	3.7%	117%
DB	4.2%	3.7%	205%
CS	4.2%	3.3%	153%
UBS	4.2%	3.3%	258%
SANTANDER	4.1%	4.5%	40%
BBVA	4.2%	4.6%	63%
UNICREDIT	4.2%	4.7%	70%
ISPM	4.2%	4.6%	78%
BNP	4.2%	4.0%	131%
CASA	4.2%	4.0%	124%
SG	4.2%	4.0%	102%
Average		4.4%	

Figure 7.8: Post Basel III Pre Tax COD; Source: author. Date: 19th March 2015.

Beta Analysis	Market Cap	Adjusted Beta	TA/TE	Relevered	
				Unlevered Beta	Beta at 12x TA/T2
BARCLAYS	37,889	1.28	22.8x	0.08	0.87
HSBC	125,945	1.07	16.1x	0.09	1.01
LLOYDS	53,052	0.99	20.0x	0.07	0.76
RBS	40,237	1.29	20.4x	0.08	0.97
STANDARD	30,251	1.02	16.1x	0.08	0.96
COMMERZBANK	14,425	1.07	26.9x	0.05	0.62
DB	37,330	1.09	30.3x	0.05	0.56
CS	40,653	1.27	26.0x	0.07	0.76
UBS	62,855	1.25	21.4x	0.08	0.90
SANTANDER	91,529	1.09	19.7x	0.07	0.85
BEVA	56,464	1.19	15.8x	0.10	1.14
UNICREDIT	36,841	1.34	17.8x	0.10	1.15
ISPM	39,577	1.29	16.6x	0.10	1.17
BNP	67,096	1.21	24.9x	0.07	0.75
CASA	30,633	1.30	30.0x	0.06	0.68
SG	32,885	1.53	25.1x	0.08	0.95
Average		1.21	21.9x	0.08	0.88

Figure 7.9: Post Basel III Beta Analysis; Source: author. Date: 19th March 2015.

COE Analysis	RFA	Beta	ERP	COE	% Change
BARCLAYS	3.00%	0.87	9.03%	10.9%	-23%
HSBC	3.00%	1.01	9.03%	12.1%	-1%
LLOYDS	3.00%	0.76	9.03%	9.9%	-14%
RBS	3.00%	0.97	9.03%	11.7%	-17%
STANDARD	3.00%	0.96	9.03%	11.7%	-1%
COMMERZBANK	2.00%	0.62	8.94%	7.5%	-29%
DB	2.00%	0.56	8.94%	7.0%	-35%
CS	2.00%	0.76	8.31%	8.4%	-25%
UBS	2.00%	0.90	8.31%	9.5%	-13%
SANTANDER	2.00%	0.85	10.26%	10.7%	-21%
BEVA	2.00%	1.14	10.26%	13.7%	-6%
UNICREDIT	2.00%	1.15	10.61%	14.2%	-15%
ISPM	2.00%	1.17	10.61%	14.5%	-10%
BNP	2.00%	0.75	9.23%	9.0%	-29%
CASA	2.00%	0.68	9.23%	8.3%	-38%
SG	2.00%	0.95	9.23%	10.7%	-31%
Average				10.6%	

Figure 7.10: Post Basel III COE; Source: author. Date: 19th March 2015.

Excess Returns	2016 ROE	COE	ROE-COE
BARCLAYS	8.2%	10.9%	-2.63%
HSBC	10.0%	12.1%	-2.07%
LLOYDS	13.2%	9.9%	3.28%
RBS	6.0%	11.7%	-5.71%
STANDARD	10.5%	11.7%	-1.17%
COMMERZBANK	4.8%	7.5%	-2.68%
DB	7.8%	7.0%	0.77%
CS	12.6%	8.4%	4.22%
UBS	10.0%	9.5%	0.50%
SANTANDER	11.9%	10.7%	1.20%
BBVA	10.6%	13.7%	-3.11%
UNICREDIT	6.9%	14.2%	-7.28%
ISPM	7.8%	14.5%	-6.65%
BNP	9.2%	9.0%	0.28%
CASA	7.6%	8.3%	-0.69%
SG	8.6%	10.7%	-2.11%
Average	8.8%	10.6%	-1.8%

Figure 7.11: Post Basel III Excess Returns; Source: author. Date: 19th March 2015.

Equity Weighting	Equity Weighting	Current Leverage Ratio	Equity Deficit to Target Lev Ratio	Assets	Target B3 Leverage Ratio
BARCLAYS	6.0%	4.4%	14,631	1,314,899	7%
HSBC	6.5%	6.2%	-19,832	2,753,593	7%
LLOYDS	5.9%	5.0%	4,288	843,940	7%
RBS	6.6%	4.9%	6,072	1,011,108	7%
STANDARD	6.4%	6.2%	-4,828	690,138	7%
COMMERZBANK	5.9%	3.7%	10,415	582,590	7%
DB	6.2%	3.3%	36,572	1,665,410	7%
CS	6.3%	3.9%	14,707	891,580	7%
UBS	6.0%	4.7%	8,155	982,604	7%
SANTANDER	7.6%	5.1%	4,934	1,188,043	7%
BBVA	6.8%	6.3%	-5,227	617,131	7%
UNICREDIT	6.1%	5.6%	-956	838,689	7%
ISPM	6.6%	6.0%	-3,366	628,305	7%
BNP	6.0%	4.0%	28,276	1,906,625	7%
CASA	5.5%	3.3%	32,893	1,518,126	7%
SG	5.7%	4.0%	20,018	1,322,617	7%

Figure 7.12: Post Basel III Estimated Leverage Ratio; Source: author. Date: 19th March 2015.

B3 WACC	COE	Equity Weighting	After tax COD	Debt Weighting	WACC	Pre B3 WACC	% Change
BARCLAYS	10.9%	6.0%	5.3%	94.0%	5.7%	2.7%	108%
HSBC	12.1%	6.5%	5.3%	93.5%	5.7%	2.9%	97%
LLOYDS	9.9%	5.9%	5.3%	94.1%	5.6%	3.4%	63%
RBS	11.7%	6.6%	5.4%	93.4%	5.8%	2.9%	99%
STANDARD	11.7%	6.4%	5.3%	93.6%	5.7%	3.1%	83%
COMMERZBANK	7.5%	5.9%	3.7%	94.1%	4.0%	2.1%	89%
DB	7.0%	6.2%	3.7%	93.8%	3.9%	1.6%	143%
CS	8.4%	6.3%	3.3%	93.7%	3.6%	1.8%	105%
UBS	9.5%	6.0%	3.3%	94.0%	3.7%	1.4%	153%
SANTANDER	10.7%	7.6%	4.5%	92.4%	5.0%	4.0%	25%
BEVA	13.7%	6.8%	4.6%	93.2%	5.2%	3.7%	40%
UNICREDIT	14.2%	6.1%	4.7%	93.9%	5.3%	3.6%	45%
ISPM	14.5%	6.6%	4.6%	93.4%	5.3%	3.6%	48%
BNP	9.0%	6.0%	4.0%	94.0%	4.3%	2.2%	92%
CASA	8.3%	5.5%	4.0%	94.5%	4.2%	2.2%	94%
SG	10.7%	5.7%	4.0%	94.3%	4.3%	2.5%	71%
Average	10.6%		4.4%		4.8%	2.7%	85%

Figure 7.13: Post Basel III Estimated WACC; Source: author

weighting, we finally arrive at the post-Basel III pre-tax WACC estimates demonstrated in Figure 7.13. The average WACC is estimated to be 4.8%, or 85% higher than the current level.

7.2 Robustness Analysis

Due to the sensitivity of the analysis to the multiples variables and assumptions, we run some tests on the WACC by setting different values for our main assumptions on senior Bail-in premium, agency cost of Bail-in for CoCo bonds, Basel TA/TE and Basel III leverage ratio. The potential value range for the post-Basel III WACC for our sample banks are demonstrated in Figures 7.14 and 7.15. As can be observed in the tables, the range of WACC estimates is given as between 4.54% to 5.22%, translating into to a 75% to 110% increase on the current WACC.

In conclusion, we have demonstrated here that even using conservative assumptions, we foresee the WACC of banks rising meaningfully on the back of the new Basel III rules (contractual Bail-in, i.e. the CoCo bonds, and statutory Bail-in, i.e. the senior debt

		Basel 3 TA/TE					
		6x	8x	10x	12x	14x	16x
Senior Bail in Premium	10 bps	4.54%	4.60%	4.66%	4.73%	4.79%	4.85%
	20 bps	4.54%	4.60%	4.67%	4.73%	4.79%	4.86%
	30 bps	4.54%	4.60%	4.67%	4.73%	4.79%	4.86%
	40 bps	4.54%	4.61%	4.67%	4.73%	4.80%	4.86%
	50 bps	4.54%	4.61%	4.67%	4.74%	4.80%	4.86%
	60 bps	4.55%	4.61%	4.67%	4.74%	4.80%	4.86%

Figure 7.14: Sensitivity Analysis 1

		Basel 3 Leverage Ratio					
		4%	6%	8%	10%	12%	14%
CoCo Agency Cost of Bail in	150 bps	4.64%	4.76%	4.88%	4.99%	5.10%	5.20%
	200 bps	4.65%	4.77%	4.88%	4.99%	5.10%	5.20%
	250 bps	4.65%	4.77%	4.89%	5.00%	5.10%	5.21%
	300 bps	4.66%	4.78%	4.89%	5.00%	5.11%	5.21%
	350 bps	4.66%	4.78%	4.90%	5.01%	5.11%	5.21%
	400 bps	4.67%	4.79%	4.90%	5.01%	5.12%	5.22%

Figure 7.15: Sensitivity Analysis 2

Bail-in) with potentially negative ramifications to the real economy. We believe the cost of equity could drop from the existing levels via lower β (though it is difficult to see the long-term β below one) and lower equity risk premium, however this is more than offset by the higher cost of debt driven by the monitoring cost of the agency costs of Bail-in, resulting in higher WACCs.

7.3 Concluding remarks

We believe that the cost of capital for banks is poised to rise on the back of the required monitoring costs and the peculiarities of the Bail-in framework. The former arises as the traditional banks' debt investors, such as mutual funds, insurers, long only funds etc., will be forced to strengthen their research capabilities (more fundamental analysts) as they will be exposed to going concern losses. Moreover, in reality any unsecured debts are effectively contingent convertible via regulatory powers, and hence passive or indexed funds will not be able to buy and hold a bank bond expecting to be fully repaid or bailed-out. They will need to monitor the fundamentals of the banks and the costs of which will, in the end, be borne by the equityholders via higher risk premium. As far as the latter are concerned, we foresee both subordinate and senior debt coupon rising as investors factor in the agency cost and the change in payout of their embedded option (debt in the upside, equity or full write-off in the downside). The compulsory solvency and leverage ratios, including the TLAC, will force the banks to issue more CoCo bonds or unsecured debts which will increase the overall cost of debt. Moreover, as soon as interest rates normalise from the current historical lows and investors' appetite for these high yielding bonds attenuate in a rising yielding environment, we envisage CoCo bonds (and to a lesser extent other unsecured debt) coupons moving closer to the pre-tax cost of equity.²⁰ Even if one assumes, as we do, a lower cost of equity on the back of a decreasing β ²¹ (via lower financial leverage and

²⁰Specially AT1 CoCo bonds that do not have the equity upside (a fixed income instrument) but have the equity downside (coupons can be suspended and their capital impaired on a going concern basis).

²¹Our unlevering and relevering β analysis shows the β of some banks falling below one. This is still a very optimistic outcome as we believe the β of the banks in general, due to the intrinsic operating / financial leverage and earnings volatility, should warrant a β above one. This should render a higher COE and thus a higher WACC under our framework.

earnings volatility), this will not keep the WACC from rising. This trend, coupled with decreasing ROE (as a result of higher equity, lower leverage, less ROE intensive businesses etc.) should put a “dent” in banks’ share prices. This may even accentuate equityholders’ risk appetite. Such possible impacts of higher WACC on the real economy is nonetheless out of the scope of this thesis

Chapter 8

Conclusion

The new financial regulation has been articulated to dampen moral hazard and to minimize the chances of another financial crisis that could jeopardize again the integrity of the banking system. However in reality, the regulator is "swapping" Bail-out for Bail-in¹, which, as discussed in this thesis, is in essence a replacement of moral hazard with agency costs (without doing away with the former though). If the burden of an ailing bank fell on the taxpayers in the past, it will now fall to the bondholders who will be required to be very mindful about the investments they own in a bank. Historically, apart from the very few cases where the bank was fully nationalized (e.g. Bankia in 2012; SNS in 2013), the equityholders would simply suffer dilution (e.g. Lloyds and ING, both in 2008), or, in many cases, were unaffected with the injection of new equity in the form of preference shares with CT1 qualification (Goldman Sachs, Morgan Stanley, etc.). Under the new Bail-in regime, the equityholders take the first losses up to the CoCo trigger point where bondholders get "written down/off" or converted into a non-admissible DES, while there is still at least 7.0% of CT1². This going-concern DAPR accentuates the agency costs that the Bail-out has introduced into the banking industry.

It is, also, possible that the new Bail-in structure may even aggravate the moral hazard problem. One could argue that the equityholders have more incentives to "gamble

¹Bail-out = moral hazard; Bail-in = moral hazard + agency costs.

²Assuming this is the CoCo trigger or the PONV.

for resurrection" when the wealth extraction comes from other investors (creditors) instead of taxpayers, as the media scrutiny, and hence the "reputational" impact, would likely be lower. Further, Bail-in may not result in restrictions on dividends or bankers' compensations as there would be with taxpayer Bail-out. While these are issues not analysed in this paper, they enhance our case that the new financial regulation may not alleviate the incentive problems as aimed.

Traditional Corporate Finance literature has underscored the detrimental effects of agency costs on the relationships between bondholders and equityholders, especially due to the limited investment of the latter. Higher equity advocated by some academics (e.g. Admati et al., (2013)) does not attenuate the problem when the equityholders enjoy the implicit put of the "Bail-in-able" balance sheet. Higher capital costs on risky investments (Risk-Weighted Asset inflation) could potentially make banks safer. However banks are volatile institutions with Non-Performing Loans and speculative trading that makes the business unpredictable. Equityholders are aware of this and they will exploit the opportunity to deviate from the Capital Asset Line in the Capital Asset Pricing Model, pursuing low Sharpe Ratio "bets" and speculate with the DAPR offered by the bondholders' put. The aggravation of this agency cost will trespass the bank's balance sheet to penetrate into the asset management industry (as the major owners of the bank's debt), and ultimately into the real economy. Wealth-transfer and value destruction are two consequences of the dominance of equityholders in their private "game" against bondholders. This is even more pronounced when bondholders do not have the chance to steer the restructuring to attain a fair agreement that partially compensates their losses, as would do in an admissible DES (Debt to Equity Swap) as analysed in Chapter 5 of this thesis.

More particularly, the DAPR brought about by Bail-in will change the profile of the trade-off between value and risk for equityholders. The relationship between risk and value becomes less concave and eventually convex as the solvency "flirts" with PONV, and equityholders can boost the riskiness of the assets without sacrificing too much of the value of the bank (in technical term the ratio of vega to delta decreases, and hence more volatility can be traded for less value). This is more acute with the new Bail-in Write-Off CoCo bond than with the Equity Conversion CoCo. However, under both structures, the high risk-

taking appetite of equityholders are higher relative to the traditional Bail-out (let alone full equity expropriation) as demonstrated in Chapter 5. Consequently we believe that bondholders' monitoring costs would rise, as they will not passively await to be reimbursed while the DAPR-induced agency costs lurk under the surface.

We also believe that covenants in CoCo bonds proposed in Chapter 6 are an effective way to curb risk-taking. When solvency is high, contractual covenants will swiftly incorporate the additional risk premium via upward coupon resetting that exerts discipline on banks and dents shareholder returns. The equityholders are not able to trade easily the bank value off against volatility for two reasons: the concave nature of the equityholders' return on equity at each ratchet trigger point, and the higher cost of capital once triggered. As solvency deteriorates and moves towards the CoCo trigger or the PONV these become less effective (as well as the fact that higher coupons erode solvency further more) as the equityholders' incentive to "gamble-for-resurrection" negate the above effects. Therefore, at this point, when CoCo bonds trade at a "distressed" level, the monitoring effort becomes ineffective. In these events we propose a different type of covenants, namely asset and debt sweeps.

Notwithstanding that, we have emphasized through-out the thesis that the current CoCo format is not admissible as it exacerbates the agency cost as well as the perverse incentive of "gambling for resurrection". The Writedown CoCo bond should be abolished as it provides "free" equity to equityholders as well as shrinking the balance sheet of the bank in an environment where lending to the real economy is tight. The Equity Conversion CoCo is a NADES that presets the conversion price in advance making equityholders losses smaller (at the expense of equityholders). In both case, especially with the former, the perverse incentives are augmented. Our CoCo proposal in Chapter 6 that converts at the prevailing share price (with a discount) when the CoCo triggers mirrors the equity raise that could take place at these distressed levels. Bondholders would be converted at a fair price and would dilute equityholders in the same way as a distressed equity raise. Thus, equityholders would have a bigger incentive to curtail risk taking or raise equity before the "painful" dilution sets in.

However, this CoCo proposal does not do away entirely with the agency costs

problem. Equityholders could shy away from any equity raise (because they lack the capital or they are not interested anymore) and “gamble for resurrection” as they “sit” comfortably on contingent capital provided by CoCo holders. Therefore, they still recover some part of their capital (if their “gamble” goes wrong) through bondholders’ losses and this could turn out to be sufficient for their risk taking “adventure”. We therefore suggest in Chapter 6 a revolutionary approach to permanently extinguish the moral hazard and the Bail-in agency cost by creating a Contingent Equity Base (CEB) contributed by future equityholders. If existing equityholders face full dilution (as it would occur if full expropriation happens in a similar fashion to SNS, Bankia or BES) on a going concern basis, equityholders would be more mindful and risk averse when taking on risk, especially as the solvency moves closer to the PONV/CoCo trigger. Our proposal suggests a generous fee for the contingent equity base to make a commitment. Having this equity line obviously makes existing equityholders worse off versus the existing structure, from the recovery value standpoint. However Bail-in, in the current format, is fundamentally flawed and has to be removed. We require a structure where equityholders can face full expropriation (without committing public money) if their financial and business decisions are mistaken. Our CEB proposal is not different from a full going concern equityholders expropriation and equityholders should come into terms with it. Bail-in is boosting the value of banks as expropriation is withdrawn from a going concern restructuring. It does not seem to bode well with the spirit of the "Absolute Priority Rule" to impose losses on a bondholder that bears all the downside and benefits from no upside. This creates perverse incentives.

In general the analysis of impact on the cost of capital of the new financial regulation has been muted from both academic and practitioners. We firmly believe that the cost of capital for banks is poised to rise on the back of the required monitoring costs and the peculiarities of the Bail-in framework as argued in Chapter 7. The former arises as the traditional banks’ debt investors, such as mutual funds, insurers, long only funds etc., will be forced to strengthen their research capabilities (more fundamental analysts) as they will be exposed to going concern losses. Moreover, in reality any unsecured debts are effectively

contingent convertible via regulatory powers, and hence some passive or indexed funds³ could not be able to buy and hold a bank bond expecting to be fully repaid or "bailed out". They will also need to monitor the fundamentals of the banks and the costs of which will in the end be borne by the equityholders via higher risk premium. As far as the latter are concerned, we foresee both subordinate and senior debt coupon rising as investors factor in the agency cost and the change in payout of their embedded option (debt in the upside, equity or full write-off in the downside). The compulsory solvency and leverage ratios, including the TLAC, will force banks to issue more CoCo bonds or unsecured debts which will increase the overall cost of debt. Moreover, as soon as interest rates normalise from the current historical lows and investors' appetite for these high yielding bonds attenuate in a rising yielding environment, we envisage CoCo bonds' coupons (and to a lesser extent other unsecured debt) moving closer to the pre-tax cost of equity, especially AT1 CoCo bonds that do not have the equity upside (a fixed income instrument) but have the equity downside (coupons can be suspended and their capital impaired on a going concern basis). Even if one assumes, as we do, a lower cost of equity on the back of a decreasing β , our unlevering and relevering β analysis demonstrates the β of some banks falling below one. This is still a very optimistic outcome as we believe the β of the banks in general, due to the intrinsic operating / financial leverage and earnings volatility, should warrant a β above one (this should even render a higher COE and thereby a higher WACC under our framework). This trend, coupled with decreasing ROE (consequently of higher equity, lower leverage, less ROE intensive businesses etc.) should put a "dent" in banks' share prices. This may even accentuate equityholders' risk appetite. Such possible impacts of higher WACC on the real economy are a topic for future research.

³Some asset managers are not allowed to invest in equity-like instruments such as CoCos.

Chapter 9

Appendix: Basel III Debt Overhang: The Special Case of the Net Stable Funding Ratio

The Net Stable Funding Ratio (NSFR) is one of the new liquidity ratios proposed by Basel III that aims at promoting a more stable funding base for banks in the long-term by improving the duration matching between assets and liabilities. During the financial crisis, many failing banks' balance sheet were characterized by long-terms assets (loans, mortgages etc.) funded by short-term liabilities (repo, short-term debt etc.). Hence the liquidity shortage that came about through the first months of the crisis prevented these banks from rolling over their debt compromising the integrity of the world financial system.

The introduction of Bail-in and the potential increase in the cost of debt via CoCo and Bail-in able debt could potentially encourage banks to issue secured debt: deposits, short-term or covered bonds (which are usually short-term debt) which are excluded from the Bail-in framework. This situation could actually worsen the maturity mismatch that in general characterizes the banking industry. To mitigate that risk, the regulator introduces the net stable funding ratio (NSFR), a new ALM (Asset Liability Management) ratio to tally the duration of both asset and liabilities to avoid the overreliance on the short-term debt market

The choice between short and long-term liabilities for banks is not an obvious one. Short-term liabilities usually command lower cost of funding for banks. It is moreover a powerful discipline tool for investors to capture the increasing risk appetite of the bank and to reflect it into the new debt¹ as the bank secures new funding. However, short-term debt is prone to liquidity “squeezes” should the bank fail to roll over the debt that leads to an increase in the default probability of the bank. Long-term debt promotes financial stability and maturity matching though it is more costly for banks². There is an additional problem which has been overlooked so far on the face of the new NSFR ratio. Long-term debt could give rise to debt overhang which could undermine the effectiveness of some of new Basel III rules (higher solvency and leverage ratios³).

In this Chapter we aim to explain the debt overhang problem of the NSFR. It discusses the debt overhang problem from the duration perspective and the trade-off between short and long-term debt from the agency cost point of view. It then briefly explains the nature, characteristics and goals of the NSFR. It also outlines the debt overhang problem in the context of the NSFR (and the presence of CoCo/Bail-in-able Debt as well) giving way to the debt overhang analytical model to show the peril of the debt overhang posed by the NSFR.

9.1 The Debt Overhang Problem: the duration perspective

The popular Modigliani and Miller model (1958) demonstrates that under “perfect” market conditions, financing and investment decisions are not correlated. However it is well known that frictions in the market such as tax costs of bankruptcy and agency costs

¹Whereas long term debt (as opposed to short term debt) does not have to be refinanced/reimbursed and thus only the yield (and not the coupon) of the security (bond or loan) captures the increasing risk premium.

²Investors tend to require a premium to compensate for lending long term as the default probability is higher. Banks need to manage the duration and interest rate risk (through hedging for example) pushing up the overall cost of funding.

³Strictly speaking, regulators and governments cannot force banks to lend (even after a Bail in) provided that they are still private entities with enough capital and liquidity. Even if a CoCo triggers at 7% to restore Core Tier 1 at 10%, the bank can still suffer from debt overhang as it cannot be legally forced to lend to the real economy (as it happened during the sovereign crisis). This can prompt banks to forego positive NPV projects.

somehow undermine this postulate. It is the latter, the agency cost in general, and the debt overhang in particular, the focus of this Chapter.

The debt overhang is one of the typical agency costs between equityholders and bondholders and was first outlined by Myers (1977). There are instances where indebted banks (and corporate firms) may bypass profitable projects as they increase not only the value of the equity but also the value of the debt and their immediate benefits accrue to debt holders⁴ instead of equityholders. Hence, should the increase in the value of the debt exceed the NPV of the investment, this positive NPV project for the firm results in a negative NPV project for equityholders. If so, the project is not undertaken and the debt overhang underinvestment problem gives rise to an agency cost that lowers the firm value.⁵ The debt overhang problem is more relevant for banks than for companies due to the maturity transformation and financing role banks play in the real economy. The aftermath of the 2007-2009 and the 2011-2013 sovereign crises are two illustrative cases of debt overhang where highly levered (and “Bailed-out”) banks bolstered solvency and capital ratios (to comply with the new Basel III rules) by decreasing lending and shredding assets. This has had pernicious consequences, especially in the Eurozone, where the biggest banks have curtailed lending and financing by 15% since 2008.

In the debt overhang underinvestment model of Myers, short-term debt is reimbursed before the investment is undertaken and thereby the company is free of agency cost. However, there are many instances where both long and short-term debts mature after the investment has been carried out (Diamond and He (2011)) leading to agency costs. Short-term debt comes with little or no debt overhang (Calomiris and Kahn (1991), Diamond and He (2011), Flannery (1994), Myers (1977)) provided that the debt can be refinanced easily. Nonetheless, if there is a liquidity crisis and the short-term cost of funding rises, the short-term debt overhang⁶ can actually be more pronounced than the long-term one (Vu, Brown,

⁴Via debt repayment or lower default rate.

⁵Moyen (2007) reports a 2.61% and 4.98% loss in firm value owing to underinvestment stemming from both long and short term debt overhang respectively.

⁶Basel III has included a new compulsory liquidity ratio that aims to promote short term liquidity in the banks. Going forward they should be able to withstand a 30 day liquidity shortage period with their own liquid assets.

Chai (2011)). So the debt overhang does depend on the bank's financing strategy and the liabilities profile (seniority, maturity etc.⁷). According to Myers (1977), if a company has a lucrative investment decision and has repaid all its short-term debt, then the company is free from agency costs of debt and undertakes the project. However, if the debt maturity is longer and the company invests in the project (especially a “distressed” company), the proceeds are shared or even transferred to debt holders (wealth transfer) at maturity via lower risk of default (and higher value of the debt). Consequently, it seems that long-term debt poses a higher debt overhang than the short-term debt.

It seems there is no straightforward answer to solve the debate between short and long-term overhang. What is clear is that debt overhang does influence investment and default decisions of equityholders (Diamong and He, (2011)). The decision of investing in a positive NPV project can pose short-term debt overhang, if the default risk is high and short-term bondholders are repaid through the proceeds (or no debt overhang if the company is risk-free and all benefits accrue to equityholders), or otherwise long-term overhang, as the proceeds lower the default probability of bondholders at maturity. Therefore, the timing of the debt maturity is a relevant issue for banks, especially now with the introduction of the NSFR that forces banks to acquire or term out their long-term debt funding.

9.2 The Net Stable Funding Ratio (NSFR)

The NSFR aims to reduce the maturity mismatch between asset and liabilities and hence the funding risk by ensuring that all banks hold a reasonable amount of stable funding based on the maturity profile of their assets. The NSFR counterbalances and curbs the incentives to hold short-term debt stemming from Bail-in and the liquidity ratio⁸ by reducing the amount of short-term liabilities that can fund long-term assets. The NSFR is calculated by dividing the available stable funding (ASF) by the required stable funding (RSF). The ratio has to be always higher than 1:

⁷Whether the debt is short or long term, secured or unsecured etc.

⁸The former gives incentives to issue non Bail in able or secured debt (cash, repo, covered bonds etc) whereas the latter encourages banks to hold cash and highly liquid short term instruments.

$$(\text{Available Stable Funding})/(\text{Required Stable Funding}) > 100\%$$

The amount of ASF is calculated by applying weightings to different liabilities. Then, they are compared with the amount of RSF through the application of weightings to all the assets and off balance sheet items of the bank. The NSFR will ensure stable funding on an ongoing basis especially when:

- The bank is undergoing a sharp fall in profitability and solvency owing to market, credit or operational risk (either systemic or idiosyncratic risk).
- The bank has been downgraded triggering a heightened credit or counterparty risk.
- The bank's reputation or credit quality has been called into question arising from a material event (probe, rogue trading etc.)

In the last Basel III monitoring exercise (December 2013) conducted by the EBA (European Banking Authority) the average NSFR was 105% among 130 European banks, 78% met or exceeded the minimum NSFR requirement (100%) with a stable funding shortfall of €470mn (2% assets). Therefore, European banks have come a long way with meeting this compulsory liquidity ratio. Figure 9.1 demonstrates the continuous increase in the NSFR since 2011 with a steady growth in ASF boding well with the active long-term debt issuance of banks over the last three years. What this report does not show though is the acute deleveraging undertaken by banks through-out the sovereign crisis which has enabled the banks to achieve the NSFR in a short period of time (Figure 9.2).

9.3 The Debt Overhang in the Context of the NSFR

As described in the quest of doing away with the intrinsic problems of the banking industry namely low equity, high leverage and asset-liability mismatch, Basel III comes up with a new liquidity ratio, the NSFR, to tackle the traditional mismatch between assets and liabilities duration in the banking industry. Conceptually, this ratio could undermine the effectiveness of other measures, namely higher capital ratios and loss-absorbing instruments which aims at, among others, reducing the debt overhang in a financial crisis. On the one

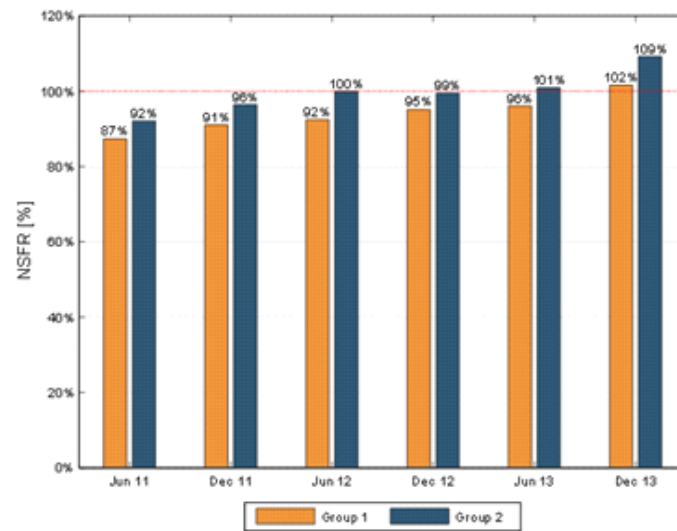


Figure 9.1: Evolution of the NSFR; Source: Basel III Monitoring Exercise, Dec 2013 EBA & author

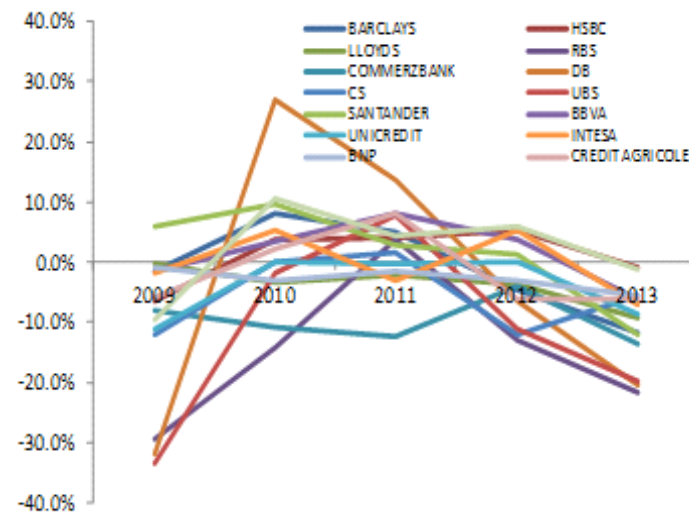


Figure 9.2: Asset Growth Evolution since 2009; Source: Annual reports & author

hand, banks are incentivized to issue low cost secured debt (as it falls out of the scope of Bail-in) with short maturities. On the other hand, systemic banks are required to comply with a compulsory Total Loss-Absorbing Capacity (TLAC)⁹ thereby forced to issue long-term unsecured Bail-in able debt. Therefore, the TLAC and the NSFR neutralize the appeal of secured debt¹⁰ as a funding source for banks pushing up the overall cost of funding for banks. Not only will the NSFR extend the duration and cost of the right hand side of the balance sheet but it could moreover give rise to debt overhang, an event which has been overlooked by the regulator.

We believe that, through the new Bail-in and liquidity framework, short-term overhang in banks has been attenuated. Recall, short-term debt overhang arises in entities that are facing financial distress and requires to roll over short-term debt as it comes due. If they fail to do so, they default. Banks, as going concern entities that should not fail¹¹ in the future, will be forced to operate with high liquidity (liquidity ratio and NSFR) and equity (Core Tier 1) buffers as well as loss-absorbing instruments (CoCos) boosting solvency levels. This would dampen any liquidity shortage fear and minimize the likelihood of another financial crisis and thus the default probability in the short-term. Consequently, banks will not rely as much on short-term debt¹² as in the past.

However, long-term debt overhang can arise on the back of the liability duration extension (via NSFR) especially in times of stress when the bank's solvency is low or CoCos (or Bail-in able debt) have been triggered. In the former, the bank will strive to bolster and replenish capital ratios especially through deleveraging¹³ so it could bypass any positive NPV project (that consumes capital within the solvency ratios) that transfers wealth to

⁹Guidance is around 8%-10% of liabilities or 23%-25% of RWA for systemic banks. Thus, European banks must fulfil the TLAC using contractual (CoCos) or statutory (Tier 2, Senior etc) loss absorbing going concern instrument and non systemic banks (also systemic) are required to meet the MREL as explained in previous sections.

¹⁰Banks can then issue longer term secured debt but the cost will rise and the asset expansion will be constrained by the leverage ratio (5%-7% assets).

¹¹Due to systemic risk, deposit runs etc.

¹²The repo market funding cost is on the rise and banks are implementing measures to reduce their reliance on this market.

¹³We show later how equityholders will be reluctant to raise equity at depressed prices as well as missing out on the opportunity to share losses with CoCo holders should solvency ratios keep deteriorating.

bondholders. In the latter, the ultimate beneficiaries of this going concern recapitalization are either the Bail-in-able (however not Bailed-in) debt (Senior, Tier 2 bonds etc.) or the secured debt (covered bonds, deposits etc.) or both. They now “sit” on a higher capital cushion bringing down the default probability embedded in the price of the unsecured debt. Assuming the CoCo has restored the capital ratio to the minimum level set out by the regulator, the bank (and equityholders) could be dissuaded from pursuing a positive NPV project as the payoffs are received by the long-term bondholders (via coupon and principal repayment as well as a lower probability of default embedded in the market price of their instrument).

Consequently, it seems that the debt overhang is “seeded” by the NSFR, lurks through-out the normal operations of the bank and looms as soon as the bank solvency is compromised, especially should contractual or statutory Bail-in be invoked. Then, any positive NPV investment could be foregone as the payoffs quickly accrue to the debtholders at maturity which are now longer in time. If the short-term debt overhang was more relevant in the past arising from the funding mix (high proportion of short-term debt) and the default probability (banks could actually default i.e. Lehman), long-term debt overhang risk is now more pronounced. Regulators, through a combination of different solvency and liquidity rules, are mitigating the short-term default risk (and hence the short-term overhang) but aggravating the long-term debt overhang by lengthening the duration of the liabilities. In other words, once solvency ratios are replenished through Bail-in or equity raising, there is no compulsory piece of legislation that forces the banks to invest in positive NPV projects¹⁴. Consequently, the main beneficiaries of the positive NPV investments are long-term bondholders. This potential wealth transfers from equity to debt could become a constraint (for investing and financing the real economy) to the banking industry and aggravate the debt overhang problem.

¹⁴Reason why the recent ECB measures (LTRO, ultra low interest rates, senior ABS bond buying etc) have failed to feed through to the real economy as NPLs-riddled banks are struggling to raise capital to comply with the new solvency rules.

9.4 Illustration of the Debt Overhang in Banks Under the NSFR

In the above sections we argue that debt overhang can arise as a result of the increasing duration of the banks' liabilities, especially in time of "financial" distress as banks will strive to replenish and bolster capital to market levels (and not just the mandatory minimum ratios). Under Basel III, Debt Overhang (DO) could arise under two scenarios:

1. Equityholders can be reluctant to raise capital to fund new projects, as the solvency ratio deteriorates that lowers the probability of imposing "losses" on CoCo holders. As shown in previous chapters, this is obvious with Writedown/Off styled bonds but also with Equity Conversion bonds due to the Non Admissible Debt to Equity Swap¹⁵. Imagine a 8% Core Tier 1 bank with a 7% trigger Writedown CoCo whose equityholders consider to issue external equity (and not subscribed by incumbent shareholders) to prop up capital and invest in a positive NPV project. The share price is so low that shareholders are reluctant to issue capital at these levels to bring in new investors (and suffer dilution). Moreover, the presence of a CoCo (which is already trading at "distressed" high yield levels) is a deterrent to invest since any equity raise (or the payoff of any positive NPV project investment) will quickly accrue to CoCo holders (via higher value of debt). Furthermore, they could miss out on the opportunity to share losses with them exacerbating the wealth transfer from equity to debt.

Berg and Kaserer (2011) proposes the following metric for the magnitude of DO. In the absence of DO, one dollar of equity contribution increases the asset value by the same amount. However, in the presence of DO, the increase in the asset value required to motivate equityholders to invest one dollar is greater than one. Then,

$$E(A_t) + 1 = E(A_t + y) \quad (9.1)$$

where E = Equity, A = Value of the Assets

¹⁵Shareholders suffer dilution but they still have the incentive to "steal" bondholders as the CoCo price and conversion terms are preset in advance at higher levels (Non Admissible Debt to Equity Swap).

Using Taylor expansion,

$$y \approx \frac{1}{\Delta}$$

and hence the inverse of the delta is a proxy for the degree of DO that the presence of Bail-in in general and CoCos in particular can lead to. Therefore, equityholders can be reticent to invest new equity in a low solvency environment (where the Core Tier 1 is close to the CoCo trigger or PONV¹⁶) because it decreases the probability of imposing losses on CoCo or Bail-in able debt holders.

2. When solvency ratios are low and close to the CoCo Trigger/PONV or either CoCos or liabilities have been “bailed in” through contractual or statutory rules and solvency restored to the mandatory level set out by the regulator, any positive NPV project could be forgone since the positive payoff will automatically accrue to long-term bondholders via lower probability of default¹⁷. Moreover, the bank will strive to bring its capital ratios in line with peers, among other things, not to pay a premium for its cost of debt, which will make the management and equityholders reluctant to invest and transfer wealth to bondholders.

Figure 9.3 demonstrates the sequence of a bank whose solvency ratios are deteriorating and could undergo debt overhang (when facing a positive NPV project) on the back of the increasing duration of its liabilities.

At $T = 0$, the bank is operating with a Basel III Core Tier 1 (CT1) of 9.5% and is aiming for a 10.5% Fully Loaded (including the Combined Buffer¹⁸) Basel III CT1 (FLCT1) by 2019¹⁹. Market peers are running a 11.5% Fully Loaded CT1²⁰ (PFLCT1). Therefore the bank is building up capital to comply with the FLCT1 however its objective is to “catch

¹⁶Point of Non Viability.

¹⁷And through the NSFR the amount of long term debt is much higher than in the past.

¹⁸Including the capital conservation, countercyclical, and systemic (for TBTF) buffers that will take the FLCT1 up to the 10.5%-11% levels.

¹⁹The deadline set out by Basel III.

²⁰Banks are expected to run a buffer above the FLCT1 (as they are actually operating now) amongst other reasons to run a healthy CoCo coupon coverage buffer above the Combined Buffer and keep their funding costs down.

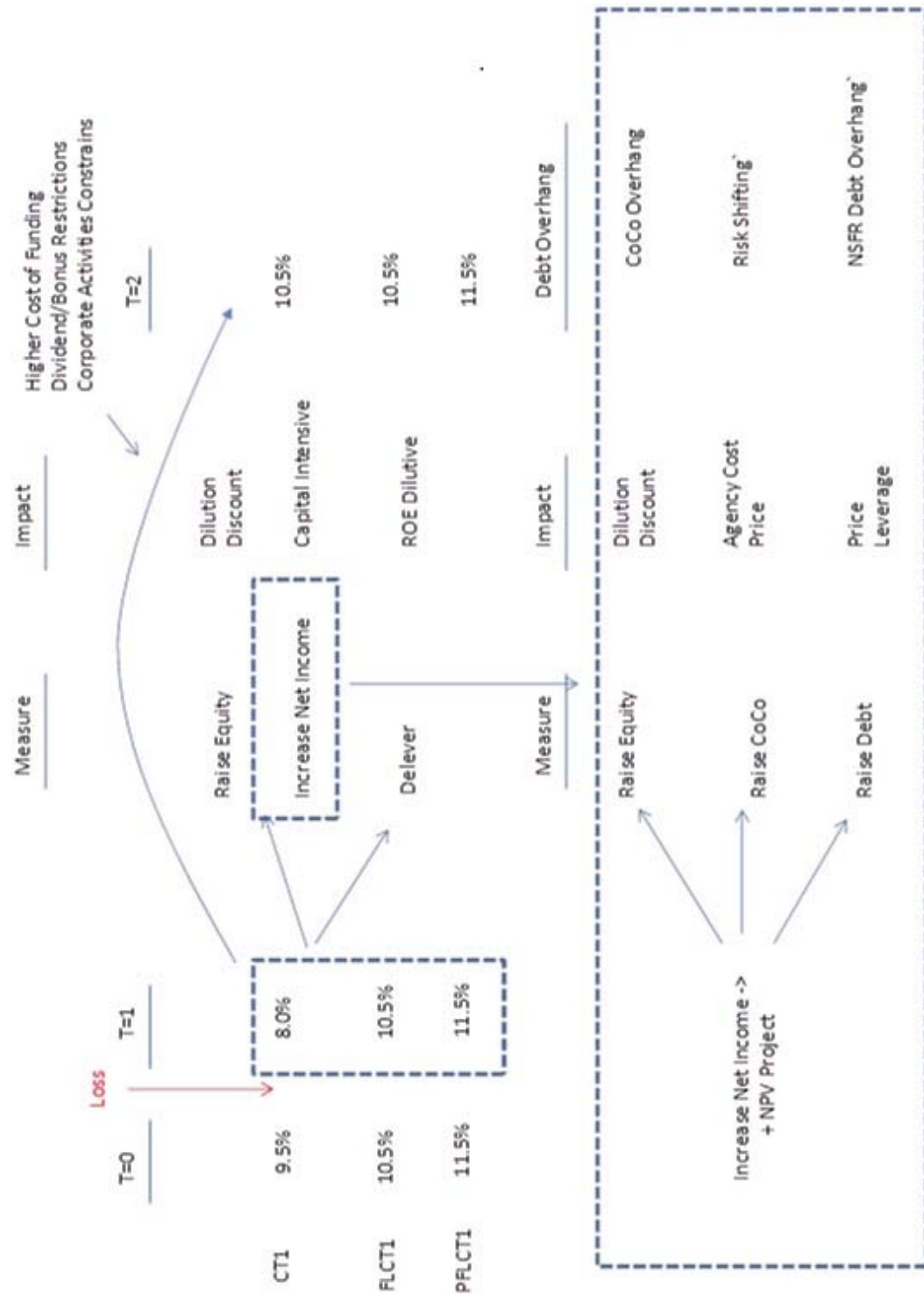


Figure 9.3: Funding choices; Source: Author

up” with peers and run similar solvency ratios (PFLCT1). Moreover, the bank is compliant with the NSFR at 100% and it boasts an ample base of liquid assets to withstand any financial distress event. The bank also has a Tier 2 CoCo with a 7% conversion trigger.

At $T = 1$, the bank experiences a one-off loss that takes the CT1 down to 8%. The CoCo is not triggered. The NSFR remains unchanged and the bank faces no liquidity shortage thanks to its ample liquid asset base. Hence, the bank experiences no short-term debt overhang²¹ thanks to the existence of long-term debt that does not have to be rolled over immediately. The bank is not in distress let alone facing any bankruptcy event.

The bank has to bolster capital to reassure investors, bondholders and the regulator which are expecting the bank to be fully compliant with the FLCT1 in the short/medium term. Until it meets its solvency targets, the bank will be forced to pay a premium for its funding costs²². Moreover, as the bank is not compliant with the FLCT1 (and thereby breaching the “Combined Buffer”) it will face dividend restrictions (however not CoCo coupon restrictions as Tier 2 bonds have mandatory coupons) for equityholders. The bank will also be closely monitored by the regulator in terms of bonus payouts for its bankers and some other corporate activities (such as mergers and acquisitions, share buybacks, etc.).

The bank has two options: increase the numerator (net income + equity) or decrease the denominator (RWA) of the CT1 ratio to achieve the FLCT1. The bank could raise equity (probably at a discount to the existing share price and would further dilute equityholders) or boost net income through profitable investments (which is capital intensive). The other option is deleveraging (which is ROE dilutive²³) through assets sale and lending “freezing”.

Now the bank is facing a positive NPV project and it is considering the investment. The project can be funded through equity (new equity or existing), junior (CoCo) or other unsecured debt. Raising new equity at a discount price and after a period of distress will not be appealing for equityholders. The signalling problem of selling new equity is aggravated by DO since the existing equityholders will only benefit if the value of the new equity

²¹A more likely event during the 2008 financial crisis.

²²Nowadays, any bank which is below the FLCT1 (though not compulsory until 2019) is paying a premium for its cost of funding, especially at the subordinated level.

²³Via lower net interest margins.

is overpriced and exceeds the overhang loss to bondholders.²⁴ Using existing equity²⁵ is capital consuming in an environment with scarcity of capital for the bank. The bank will also struggle to raise junior debt (CoCo) until the solvency ratios are restored. Bondholders will be wary of investing in a CoCo due to the agency cost attached to it and they will demand a high premium for it.

The reason why neither new equity nor CoCo are feasible at this point is due to the fact that new investors will bear the risk of further potential losses which were previously borne by existing bondholders. Since new investors will ask for a premium to invest in the bank, the increase in the wealth of the existing bondholders comes at the equityholders' expense

Tapping into the unsecured market (senior or subordinated) will not be a straightforward task either as the bank will have to pay a premium for the new debt.²⁶ So it seems that the bank could forego the investment opportunity and, provided that it is operating as a going concern entity, the regulator cannot force it to invest /lend.

Equityholders will turn their eyes on to the right side of the balance sheet to realize that most of the liabilities are long-term. Since the bank is not in financial distress, short-term debt does not lead to DO. It is the long-term debt that can give rise to DO since the bank, in the short to medium term, can conduct activities which are debtholder friendly, such as:

- Replenish capital
- Suspend dividends and share buybacks
- Abandon corporate activities such as mergers and acquisitions
- etc.

²⁴Reason why banks have resorted to asset sales rather than equity raise (which they also have) to bolster capital levels.

²⁵In reality, a dollar of investment consumes a dollar of equity and hence the solvency ratio is unchanged until the project yields profits in a reasonable time horizon.

²⁶Or if the leverage ratio (Equity/Assets) has deteriorated as a result of the loss, then it will make matters worse by increasing the leverage of the bank.

If the bank invests in the positive NPV project, the payoff will be shared with bondholders (wealth transfer) and it could turn into a negative NPV project for equity-holders.

Let us demonstrate this analytically. Let us take a bank with a current market value of its assets denoted by A^0 that follows a log-normal distribution.

The value of the assets at any time is

$$A^t = A^0 \exp\left(-\frac{\sigma^2 t}{2} + \sigma U^t\right)$$

where $U \sim N(0, t)$ and $\sigma = \text{constant volatility}$. We assume the bank complies already with the NSFR at 100%, meaning their assets and liabilities are fully matched.

At $T = 0$, the bank has equity E and long-term debt D . The existing assets generate at $T=2$

$$A \in \{A^D, A^F\}$$

where

$$\Delta A := A^F - A^D > 0$$

and

$$r := \text{Prob}[A = A^F]$$

where $A^D = \text{minimum future value of the assets with } D \text{ of debt}$ and $A^F = \text{maximum future value of the assets with } D \text{ of debt}$.

The bondholders' payoff are,

$$R(A) = \begin{cases} R^D = \text{Min}[D, A^D] & \text{if } A = A^D \\ R^F = \text{Min}[D, A^F] & \text{if } A = A^F \end{cases}$$

with $\Delta R = R^F - R^D$. The expected payoff for the bondholder is

$$rR^F + (1 - r)R^D = R^D + \Delta R$$

At $T = 1$, the bank is facing a positive NPV project. Investing Y increases the probability r to $r + \Delta r$ and thereby the project has a positive NPV so long as

$$[(r + \Delta r)A^F + [1 - (r + \Delta r)]A^D] - [rA^F + (1 - r)A^D] > Y$$

or

$$\Delta r \Delta A - Y > 0$$

If the bank finally invests in the project, bondholders payoff is increased by

$$[(r + \Delta r)R^F + [1 - (r + \Delta r)]R^D] - [rR^F + (1 - r)A^D] = \Delta r \Delta R,$$

whereas the equityholder payoff is diminished by the portion accruing to bondholders

$$\Delta r \Delta A - Y - \Delta r \Delta R.$$

Therefore the existing debt plays the role of tax on investment and hence, unless

$$\Delta r \Delta A - Y > \Delta r \Delta R$$

equityholders would bypass the project. Consequently, positive NPV projects for the firm such as

$$\Delta r \Delta R > \Delta r \Delta A - Y > 0$$

are rejected because they become non positive NPV for equityholders.

We now aim to demonstrate how the shift from short-term to long-term liabilities always give rise to DO as long as the bank is not in financial distress (Diamond (2011)). Since the value of debt is the difference between the bank and the equity value, the DO, as a measure of the agency cost, is the marginal improvement of the value of debt when the bank invests in a positive NPV project that increases the value of the bank at $T = 0$, A^0 .

The value of the debt is the present value of the debt minus a put option

$$D(A^0, D^i, t^i) = A^0(1 - N(d_i)) + D^i N(d_i - \sigma\sqrt{t^i})$$

where $d_i = \frac{\ln(V^0/D^i) + \sigma^2 t^i / 2}{\sigma\sqrt{t^i}}$, D^i = face value of debt (D^1 = short-term debt; D^2 = long-term debt); t^i = maturity (t^1 = short-term debt maturity; t^2 = long-term debt maturity).

Then the debt overhang (DO) is measured by

$$DO(A^0, D^i, t^i) = (\partial D(A^0, D^i, t^i)) / \partial A^0 = 1 - (\partial E(A^0, D^i, t^i)) / \partial A^0 = 1 - \Delta(A^0, D^i, t^i)$$

where Δ is the delta hedge for the call option under the Black-Scholes model.

This equation accounts for the impact that a change in the value of the debt has on the overall value of the bank. By looking at the difference between the short and long-term debt overhang

$$\Delta DO \equiv DO(A^0, D^1, t^1) - DO(A^0, D^2, t^2),$$

where $D^2 > D^1$ to hold the bank leverage constant,

$$D(A^0, D^1, t^1) - D(A^0, D^2, t^2) = 0$$

thereby, ΔD^i is negative which makes sense given that long-term debt always gains more from any increase in the assets in place (A^0) translating into a lower investment incentives for equityholders (Diamond (2010)). Then under a Black-Scholes-Merton framework,

$$DO(A^0, D^1, t^1) < DO(A^0, D^2, t^2)$$

whenever

$$D(A^0, D^1, t^1) = D(A^0, D^2, t^2)$$

Hence short-term debt comes with a lower overhang than long-term debt²⁷.

²⁷Except for banks that exhibit a short term high default risks (Diamond, 2010).

To conclude, with the new banks' capital regulation, the short-term DO has been attenuated through a combination of liquidity (liquidity and NSFR ratios) and solvency measures (higher equity, Bail-in etc.) that lowers the probability of a short-term default. However, the presence of higher long-term debt in a bank which is operating with low solvency ratios (before or after Bail-in or CoCo trigger) could potentially exacerbate the DO. The bank will endeavour to prop up capital which will ultimately benefit bondholders via shareholder unfriendly actions (deleveraging²⁸, dividend and share buyback suspension, constraints on ROE-accretive corporate actions such as M&A etc.). Should the bank face a positive equity-funded NPV project (and given the long-term profile of the bank's liabilities stemming from the NSFR), the bank could pass up the investment since the payoff would be quickly captured by bondholders. This wealth transfer from equity to bondholders could curb the investment appetite for equityholders until capital ratios are fully restored.

9.5 Concluding Remarks

The credit "squeeze" led by the aftermath of the financial crisis underscored the necessity of grappling with the intrinsic debt overhang of the banking industry. Basel III advocated for higher equity, lower leverage, more contingent capital and a more stable funding base. The first two seem to tackle more directly the debt overhang problem by forcing banks to hold sufficient equity to fund positive NPV projects, even in times of distress. The last two could actually counterbalance the positive effects of higher equity and lower leverage. In this Appendix we have focused on the NSFR (and briefly touching upon the CoCo related debt overhang) that leads to an extension of the liabilities duration. This feature could actually aggravate the debt overhang problem especially in times of distress when Bail-in has been invoked (contractually or statutorily) and the bank faces positive NPV projects. The presence of longer term debt than in the past curbs the incentives to fund profitable investments whose payoff accrues to long-term bondholders. Moreover, once the capital ratio has been restored to the minimum level, the bank cannot be forced to lend

²⁸It has been proved throughout the financial and sovereign crisis that shredding assets is an easier and faster capital bolstering measure.

(as proved over the financial and sovereign crisis) and will strive to raise more capital (by deleveraging for example) to achieve their (or their investors) desired capital ratio. The fact that the regulator (and the market) is expecting the banks to run “buffers” above the minimum capital ratios (for example 11.5% PFLCT1), is an incentive for banks to hoard capital until they achieve the targeted levels set out by the market/investors. Therefore, long-term debt overhang (stemming from the NSFR) can quickly arise when banks reject positive NPV projects on the back of the wealth transfer from equity to bondholders.

Chapter 10

Appendix: AT1 Summary Terms

10.1 Euro AT1s

Views Pages Settings Tools																
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Issuer	Cncy	CeCe	Issued	Call	Size	Typ	Grp	Bank	Mech	Rating (M/S/V)	Type	Spread	Schedule	Price	Type	Equity Conv
IS	CHF	8%	Jan-03	Jan-18	200	Phased	5.125%		PWD	-/-	3Y mt	520.0	Annual	NA	NA	
ZKS	CHF	5.50%	Jan-12	Jan-17	500	Phased	7%		TWD	-/-	5Y mt	290	Annual	NA	NA	
ZMB	EUR	7.80%	Mar-04	Apr-05	300	Phased	7%		TWD	-/-	12 mt	71.8	Annual	NA	NA	
RENAVY	EUR	5.75%	Jan-03	Jan-20	1200	Phased	7%	5.125%	TWD	Baa1/Baa1/Baa1	3Y mt	345.2	Annual	NA	NA	
ACAP	EUR	6.50%	Apr-04	Jun-11	1000	Phased	7%	5.125%	TWD	-/BB+/BB+	5Y mt	51.2	Revert dates	NA	NA	
ABND	EUR	7.375%	Dec-05	Dec-20	500	Phased	7%	7%	TWD	BB+/BB+	5Y mt	751.0	Semi-Annual	NA	NA	
SACK	EUR	8%	Dec-05	Dec-20	1000	Full	7%		Equity	-/BB+/BB+	3Y mt	675	Revert dates	€ 5.99	Fixed	
SACK	EUR	6.5%	Jan-14	Dec-21	1072	Full	7%		Equity	-/BB+/BB+	3Y mt	587.5	Revert dates	€ 2.02	Fixed	
RENAVY	EUR	8.875%	Apr-05	Apr-05	1000	Phased	5.125%	5.125%	Equity	Baa1/-/BB	5Y mt	817.3	Anytime	5.8	Floor	
RENAVY	EUR	6.75%	Feb-05	Feb-20	1500	Phased	5.125%	5.125%	Equity	Baa1/-/BB	5Y mt	865.0	Anytime	5.8	Floor	
RENAVY	EUR	7%	Feb-04	Feb-20	1500	Phased	5.125%	5.125%	Equity	-/BB	5Y mt	615.0	Anytime	4.3	Floor	
RENAVY	EUR	7.375%	Jan-05	Jan-20	750	Phased	5.125%	5.125%	TWD	BB+/BB+	5Y mt	691.0	Semi-Annual	NA	NA	
RENAVY	EUR	6.125%	Jan-05	Jan-20	750	Phased	5.125%	5.125%	TWD	Baa1/BBB+/BBB+	5Y mt	523	Semi-Annual	NA	NA	
RENAVY	EUR	5.875%	Feb-05	Apr-22	750	Phased	7%	7%	TWD	Baa1/BBB+/BBB+	7Y mt	547.3	Semi-Annual	NA	NA	
RENAVY	EUR	5.75%	Mar-04	Apr-20	750	Phased	7%	7%	TWD	-/BBB+/BBB+	6Y mt	564	Semi-Annual	NA	NA	
IS	EUR	8%	May-16	Apr-23	1750	Phased	5.125%		TWD	BB+/BB+	5Y mt	463.8	Revert dates	NA	NA	
RENAVY	EUR	8.875%	Jan-05	Oct-21	500	Phased	5.125%	5.125%	TWD	-/BB+	5Y mt	591	Semi-Annual	NA	NA	
RENAVY	EUR	6%	Jan-05	Dec-21	1000	Full	7%		Equity	Baa1/-/BBB	5Y mt	513.0	Revert dates	€ 2.24	Fixed	
RENAVY	EUR	5.25%	Jan-04	Dec-21	1500	Full	7%		Equity	Baa1/-/BBB	5Y mt	458.3	Revert dates	€ 1.5714	Fixed	
RENAVY	EUR	8.875%	Mar-05	Apr-21	125	Phased	7%	7%	Equity	-/-	3Y mt	815.0	Annual	3.0	Floor	
RENAVY	EUR	7%	Jan-08	Jan-21	1250	Phased	5.125%	5.125%	TWD	Baa1/B+/BB+	3Y mt	686.6	Semi-Annual	NA	NA	
RENAVY	EUR	5.825%	Mar-04	Mar-19	1400	Phased	5.125%	5.125%	TWD	-/BB/BB	5Y mt	475.0	Quarterly	NA	NA	
RENAVY	EUR	8.875%	Apr-04	Jun-20	750	Full	7%		Equity	-/BB+/BB+	3Y mt	529	Revert dates	€ 0.78	Fixed	
RENAVY	EUR	8%	Feb-05	Oct-20	500	Phased	7.125%	7.125%	PWD	-/BB+/BB+	3Y mt	390.0	Anytime	NA	NA	
RENAVY	EUR	11.1%	Oct-03	Oct-08	500	Phased	5.125%	5.125%	Equity	-/-	5Y mt	590.3	Anytime	200%	Floor	
RENAVY	EUR	8.375%	Feb-05	Apr-20	750	Phased	7%		Equity	-/BB+/BB+	5Y mt	817.8	Quarterly	15.08	Floor	
RENAVY	EUR	8.625%	Apr-05	Jun-20	1250	Phased	7%	5.125%	TWD	Baa1/B+/BBB+	3Y mt	685.7	Semi-Annual	NA	NA	
RENAVY	EUR	5.5%	Jan-05	Jun-20	1500	Phased	7%	5.125%	TWD	Baa1/B+/BBB+	5Y mt	525	Semi-Annual	NA	NA	
RENAVY	EUR	8.25%	Jan-04	Jan-21	1500	Phased	5.125%	5.125%	Equity	Baa1/-/BB	5Y mt	564	Quarterly	5.0	Floor	
RENAVY	EUR	8.25%	Mar-04	Mar-19	1500	Phased	5.125%	5.125%	Equity	Baa1/-/BB	5Y mt	541	Quarterly	4.0	Floor	
RENAVY	EUR	7%	Apr-04	Apr-21	1000	Phased	5.125%	5.125%	TWD	Baa1/-/BB+	3Y mt	653.0	Revert dates	NA	NA	
RENAVY	EUR	5.75%	Feb-05	Feb-21	1000	Phased	5.125%	5.125%	PWD	-/BB+/BB+	5Y mt	528.7	Annual	NA	NA	
RENAVY	EUR	6.75%	Jan-04	Dec-21	1000	Phased	5.125%	5.125%	TWD	-/BB+/BB+	3Y mt	610	Semi-Annual	NA	NA	
RENAVY	EUR	8%	Jan-05	Jun-20	750	Full	7%		PWD	Baa1/B+/BB+	3Y mt	554.0	Revert dates	NA	NA	
RENAVY	EUR	8%	Apr-04	Jun-20	500	Phased	7%	5.125%	TWD	-/BB+/BB+	5Y mt	455.5	Revert dates	NA	NA	
RENAVY	EUR	7.875%	Aug-05	Dec-21	1000	Full	7%		Equity	Baa1/B+/BB+	5Y mt	609.0	Revert dates	€ 1.05	Fixed	
RENAVY	EUR	7%	Jan-04	Dec-21	800	Full	7%		Equity	-/BB+/BB+	3Y mt	569.0	Revert dates	€ 1.05	Fixed	
RENAVY	EUR	8.39%	Jan-04	Nov-19	400	Full	7%		CCIS	-/BB+/BB+	5Y mt	813.0	Revert dates	€ 0.7	Fixed	
RENAVY	EUR	7.125%	May-04	Apr-20	850	Phased	5.125%		TWD	BB+/BB+	5Y mt	415.3	Revert dates	NA	NA	
RENAVY	EUR	7.875%	Apr-05	Jun-20	750	Full	7%		Equity	-/BB+/BB+	3Y mt	481	Revert dates	€ 0.62	Fixed	
RENAVY	EUR	7.625%	Apr-04	Jun-20	1400	Full	7%		Equity	-/BB+/BB+	3Y mt	581	Revert dates	€ 0.62	Fixed	
RENAVY	EUR	7%	Apr-04	Jun-20	1400	Full	7%		Equity	-/BB+/BB+	3Y mt	580	Revert dates	€ 0.62	Fixed	
RENAVY	EUR	6.875%	Mar-04	Jun-20	1000	Full	7%		CCIS	-/BB+/BB+	3Y mt	488	Revert dates	€ 0.62	Fixed	

Figure 10.1: EUR AT1 Terms; Source: AT1 Handbook; Societe Generale (2016)

10.2 USD AT1s

			First			Trigger ratio		Loss			Back-end	Call	Equity Conv.		
Issuer	Cncy	CoCo	Issued	Call	Size	Type	Grp	Bank	Mech	Rating (M/S/P)	Type	Spread	Schedule	Price	Type
ACAP	USD	8.125%	Jan-08	Dec-25	1250	Prepaid	7%	8.125%	TWO	Sub/BB+/BB-	3Y mt	618.5	Annual	Jul	Jul
ACAP	USD	7.875%	Jan-04	Jan-21	1750	Prepaid	7%	8.125%	TWO	Sub/BB+	3Y mt	499.4	Reset dates	Jul	Jul
ACAP	USD	8.625%	Sep-04	Sep-19	1250	Prepaid	7%	8.125%	TWO	Sub/BB+/BB+	3Y mt	495.7	Reset dates	Jul	Jul
ACR	USD	8.25%	Nov-11	Dec-18	2000	Full	7%		Equity	Sub/BB-	3Y mt	540.1	Reset dates	Oct-14	Fixed
ACR	USD	7.875%	Aug-08	May-22	1500	Full	7%		Equity	Sub/BB+/BB-	3Y mt	577.2	Reset dates	Oct-19	Fixed
ACR	USD	8.625%	Jan-04	Sep-18	1211	Full	7%		Equity	Sub/BB+	3Y mt	582.2	Reset dates	Oct-27	Fixed
ALUMIN	USD	8%	May-15	May-18	1500	Prepaid	8.125%	8.125%	Equity	Sub/BB	3Y mt	626.2	Anytime	Oct-18	Fixed
AMP	USD	7.625%	Mar-14	Mar-21	1500	Prepaid	8.125%		TWO	Sub/BBB+/BBB	3Y mt	611.4	Reset dates	Jul	Jul
AMP	USD	7.375%	Aug-11	Aug-25	1500	Prepaid	8.125%		TWO	Sub/BBB+/BBB	3Y mt	511	Reset dates	Jul	Jul
CB	USD	8.3%	Jul-12	Oct-18	1723	Prepaid	7%		Equity	Sub/BB	3Y mt	664	Annual	Oct-17	Fixed
CB	USD	7.3%	Dec-12	Dec-18	2250	Prepaid	8.125%		TWO	Sub/BB	3Y mt	499.8	Reset dates	Jul	Jul
CB	USD	8.25%	Jan-04	Dec-14	2500	Prepaid	8.125%		TWO	Sub/BBB	3Y mt	545.3	Reset dates	Jul	Jul
CB	USD	7.1%	Nov-04	Apr-25	1500	Prepaid	8.125%		TWO	Sub/BBB	3Y mt	508.3	Reset dates	Jul	Jul
CB	USD	8.25%	May-04	Apr-20	1250	Prepaid	8.125%		TWO	Sub/BB+/BB	3Y mt	415.8	Reset dates	Jul	Jul
CEBRIO	USD	8.75%	Mar-11	Mar-20	750	Prepaid	8.125%	8.125%	TWO	Sub/BBB+/BBB	3Y mt	607.5	Annual	Jul	Jul
CEBRIO	USD	8.50%	Oct-16	Mar-22	750	Prepaid	8.125%	8.125%	TWO	Sub/BBB+/BBB	3Y mt	588	Annual	Jul	Jul
CEBRIO	USD	8.875%	Jan-16	Jun-21	2000	Full	7%		Equity	Sub/BB+/BBB	3Y mt	511.4	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.375%	Mar-11	Mar-25	2600	Full	7%		Equity	Sub/BB+/BBB	3Y mt	436.4	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.625%	Sep-14	Jan-20	1500	Full	7%		Equity	Sub/BB+/BBB	3Y mt	562.6	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.375%	Sep-14	Sep-24	1500	Full	7%		Equity	Sub/BB+/BBB	3Y mt	546.5	Reset dates	Oct-18	Fixed
CEBRIO	USD	8%	Apr-15	Apr-20	2000	Prepaid	7%		Equity	Sub/BBB+/BBB	3Y mt	444.5	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.5%	Apr-15	Apr-20	1250	Prepaid	7%		Equity	Sub/BBB+/BBB	3Y mt	444.5	Reset dates	Oct-18	Fixed
CEBRIO	USD	7.7%	Sep-15	Sep-25	1000	Prepaid	8.125%	8.125%	TWO	Sub/BB+/BBB	3Y mt	546.15	Reset dates	Oct-18	Fixed
CEBRIO	USD	7.3%	Apr-14	Jun-21	1675	Full	7%		Equity	Sub/BB+/BBB	3Y mt	476	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.5%	Sep-14	Sep-19	3000	Full	8%	8.125%	TWO	Sub/BBB+/BBB	3Y mt	546.1	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.125%	Sep-14	Sep-24	500	Full	8%	8.125%	TWO	Sub/BBB+/BBB	3Y mt	518.8	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.25%	Mar-15	Sep-21	350	Full	8%	8.125%	TWO	Sub/BBB+/BBB	3Y mt	516.4	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.4%	Nov-11	Jun-17	2000	Full	8%		TWO	Sub/BBB+/BBB	3Y mt	740	Anytime	Jul	Jul
CEBRIO	USD	8.625%	Aug-10	Aug-21	2000	Full	7%		Equity	Sub/BBB+/BBB	3Y mt	779.8	Reset dates	Oct-18	Fixed
CEBRIO	USD	8%	Aug-11	Aug-25	1500	Full	7%		Equity	Sub/BBB+/BBB	3Y mt	521	Reset dates	Oct-18	Fixed
CEBRIO	USD	7.5%	Aug-11	Aug-20	2000	Full	7%		Equity	Sub/BBB+/BBB	3Y mt	580	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.875%	May-11	May-19	1500	Prepaid	8.125%	8.125%	Equity	Sub/BB+/BBB	3Y mt	478.8	Quarterly	Oct-18	Fixed
CEBRIO	USD	8.75%	Nov-14	Mar-20	1200	Full	8%	8.125%	TWO	Sub/BB+/BBB	3Y mt	580	Anytime	Jul	Jul
CEBRIO	USD	8.25%	Feb-15	Mar-21	1200	Full	8%	8.125%	TWO	Sub/BBB+/BBB	3Y mt	533.5	Reset dates	Jul	Jul
CEBRIO	USD	8.25%	Sep-13	Nov-18	1200	Prepaid	8.125%		TWO	Sub/BBB+/BBB	3Y mt	619.4	Reset dates	Jul	Jul
CEBRIO	USD	8%	Sep-13	Sep-25	1200	Prepaid	8.125%		TWO	Sub/BBB+/BBB	3Y mt	547.5	Reset dates	Jul	Jul
CEBRIO	USD	7.875%	Sep-13	Sep-21	1500	Prepaid	8.125%		TWO	Sub/BBB+/BBB	3Y mt	611.8	Reset dates	Jul	Jul
CEBRIO	USD	7.875%	Dec-11	Dec-25	1750	Prepaid	8.125%		TWO	Sub/BBB+/BBB	3Y mt	497.0	Reset dates	Jul	Jul
CEBRIO	USD	8%	Jan-14	Jan-20	1500	Prepaid	8.125%		TWO	Sub/BB+/BBB	3Y mt	406.7	Reset dates	Jul	Jul
CEBRIO	USD	7.3%	Aug-16	Apr-22	2000	Full	7%		Equity	Sub/BBB+/BBB	3Y mt	630.1	Reset dates	Jul	Jul
CEBRIO	USD	8.3%	Apr-15	Apr-20	2000	Full	7%		Equity	Sub/BBB+/BBB	3Y mt	488.0	Reset dates	Oct-18	Fixed
CEBRIO	USD	8.5%	Feb-15	Mar-20	750	Full	8%	8.125%	Equity	Sub/BBB+/BBB	3Y mt	546.7	Reset dates	Oct-18	Fixed
CEBRIO	USD	7.125%	Aug-14	Aug-21	1500	Prepaid	7%		TWO	Sub/BBB+/BBB	3Y mt	548.1	Annual	Jul	Jul
CEBRIO	USD	7.125%	Feb-15	Feb-20	1200	Prepaid	7%		TWO	Sub/BBB+/BBB	3Y mt	546.4	Annual	Jul	Jul
CEBRIO	USD	7%	Feb-15	Feb-25	1200	Prepaid	8.125%		TWO	Sub/BBB+/BBB	3Y mt	486.5	Annual	Jul	Jul
CEBRIO	USD	8.875%	Mar-16	Mar-21	1500	Prepaid	7%		TWO	Sub/BB+/BBB	3Y mt	549.7	Annual	Jul	Jul
CEBRIO	USD	8.875%	Aug-11	Aug-25	1575	Prepaid	7%		TWO	Sub/BB+/BBB	3Y mt	491	Annual	Jul	Jul
CEBRIO	USD	8%	Apr-14	Jun-24	1200	Prepaid	8.125%	8.125%	TWO	Sub/BBB+/BBB	3Y mt	518	Reset dates	Jul	Jul

Figure 10.2: USD AT1 Terms; Source: AT1 Handbook; Societe Generale (2016)

10.3 Senior and Tier 2 CoCos

Issuer	Host	Cncy	CoCo	First		Size	Trigger ratio		Bank	Mech	Rating (M/S/I)	Back-end		Call	Equity Conv	
				Issued	Call		Type	Grp				Type	Spread		Price	Type
ACAF?	Tier 2	USD	8.125% 13	Sep-13	Sep-18	1000	Phased	7%		PwD	-/BBB-/BBB-	SY ms	628.3	Semi-Annual	NA	NA
BACR	Tier 2	USD	7.625% 12	Nov-12		3000	Phased	7%		PwD	-/BBB+/BBB-	-	-	-	NA	NA
BACR	Tier 2	USD	7.75% 23	Apr-13	Apr-18	1000	Phased	7%		PwD	-/BBB+/BBB-	SY ms	683.3	Onetime	NA	NA
CS	Tier 2	USD	6.5% 23	Aug-13		2500	Phased	5%		PwD	-/BBB-/BBB-	-	-	-	NA	NA
CS	Tier 2	EUR	5.75% 23	Sep-13	Sep-20	1250	Phased	5%		PwD	-/BBB-/BBB-	SY ms	400	Onetime	NA	NA
CS	Tier 2	CHF	7.125% 22	Mar-12	Mar-17	750	Phased	7%		Equity	-/-/BBB+	SY ms	668.5	Onetime	CHF 20	Flot
KEC	Tier 2	USD	8% 23	Jan-13	Jan-18	1000	Phased	7%		PwD	-/BBB-/-	SY ms	709.2	Onetime	NA	NA
NYKRE	Tier 2	EUR	4% 36	Jun-14	Jun-21	600	Phased	7%	7%	PwD	-/BBB-/BBB-	SY ms	285	Annual	NA	NA
UBS	Tier 2	USD	7.625% 22	Aug-12		2000	Phased	5%		PwD	-/BBB+/BBB-	-	-	-	NA	NA
UBS	Tier 2	EUR	4.75% 24	Feb-14	Feb-21	2000	Phased	5%		PwD	-/BBB+/BBB-	SY ms	340	Onetime	NA	NA
UBS	Tier 2	USD	5.125% 24	May-14		2500	Phased	5%		PwD	-/BBB+/BBB-	-	-	-	NA	NA
UBS	Tier 2	USD	7.25% 22	Feb-12	Feb-17	2000	Phased	5%		PwD	-/BBB+/BBB-	SY ms	606.1	Onetime	NA	NA
UBS	Tier 2	USD	4.75% 23	May-13	May-18	1500	Phased	5%		PwD	-/BBB+/BBB-	SY ms	336.5	Onetime	NA	NA
XXB	Tier 2	EUR	2.63%	Jun-15	Jun-22	500	Phased	5%		PwD	-/A/-	SY ms	385	Onetime	NA	NA
RABOBK	Sen	EUR	6.875% 20	Mar-10		1250	ECR	7%		75%W/D	Baa2/-/-	-	-	-	NA	NA

Figure 10.3: Senior and Tier 2 CoCos Terms; Source: AT1 Handbook; Societe Generale (2016)

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